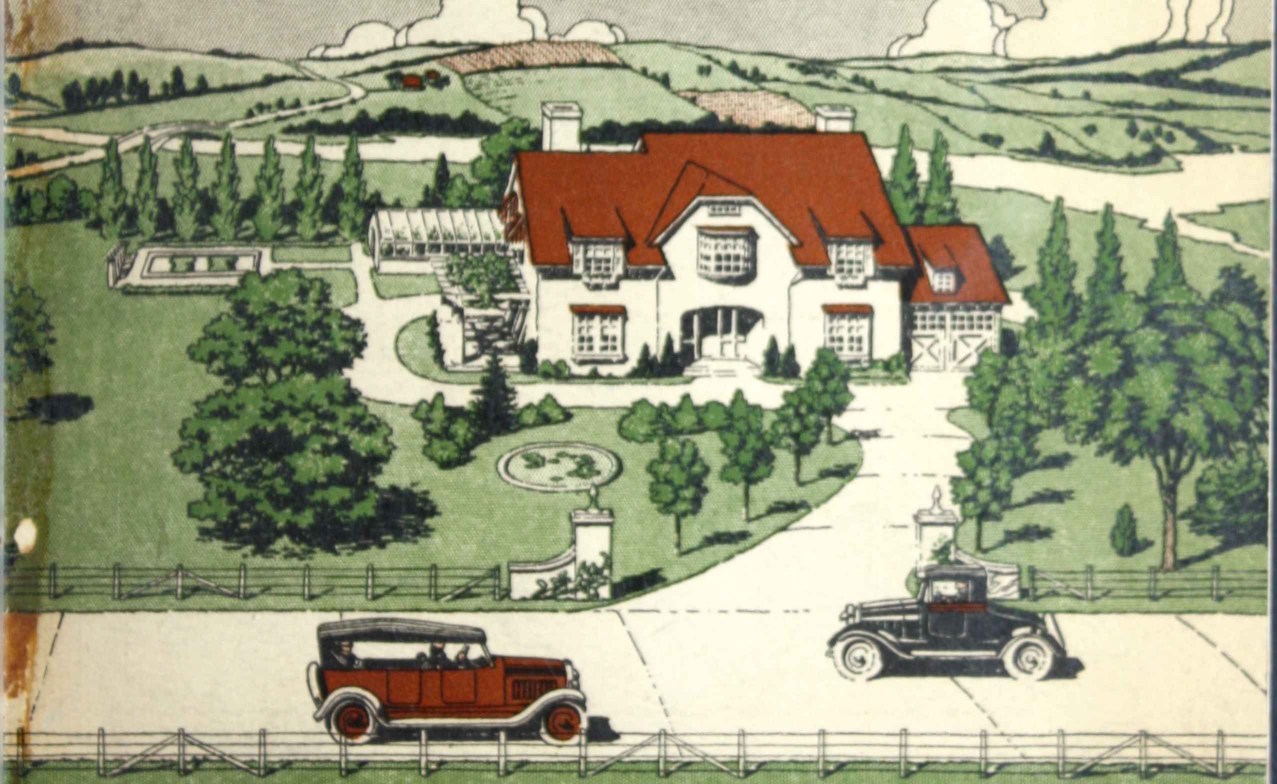
691.5

ALPHA CEMENT

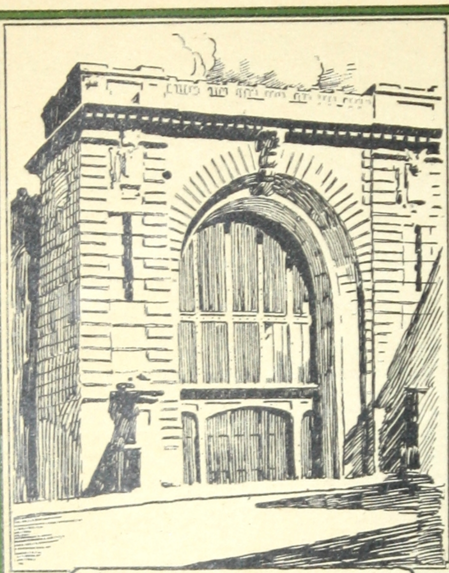
How to use it



A Practical Handbook

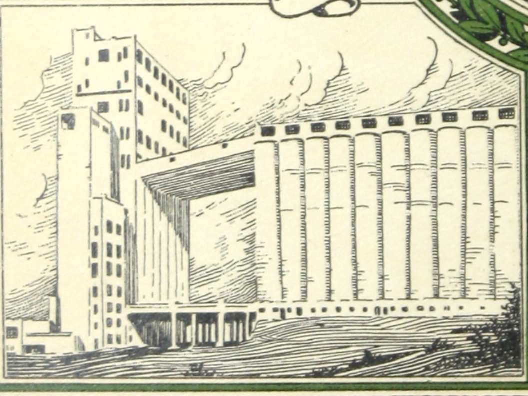
Built with ALPHA CEMENT

EXAMPLES *of* LARGE BUILDINGS & GREAT ENGINEERING UNDERTAKINGS IN WHICH ALPHA CEMENT WAS USED AFTER MEETING SEVERE TESTS FOR HIGH QUALITY



Naval Academy Armory
Annapolis, Maryland

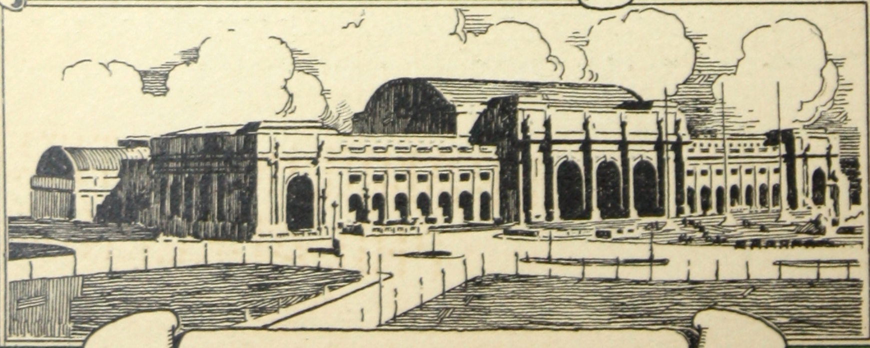
The
New York Aqueduct



Missouri Pacific Elevator, St Louis, Mo
2,000,000 Bu Grain Elevator

Bush Terminal Buildings
New York

ROSÉ

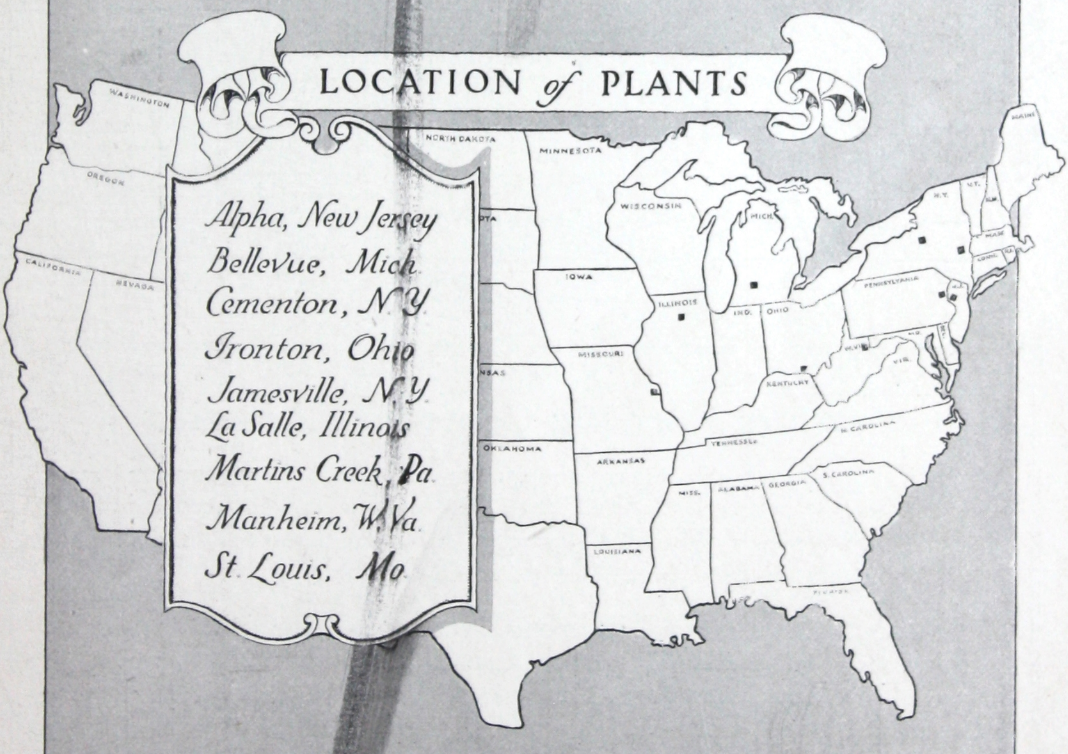


Union Station, Washington, D.C.

ALPHA CEMENT

HOW TO USE IT

A Practical Handbook

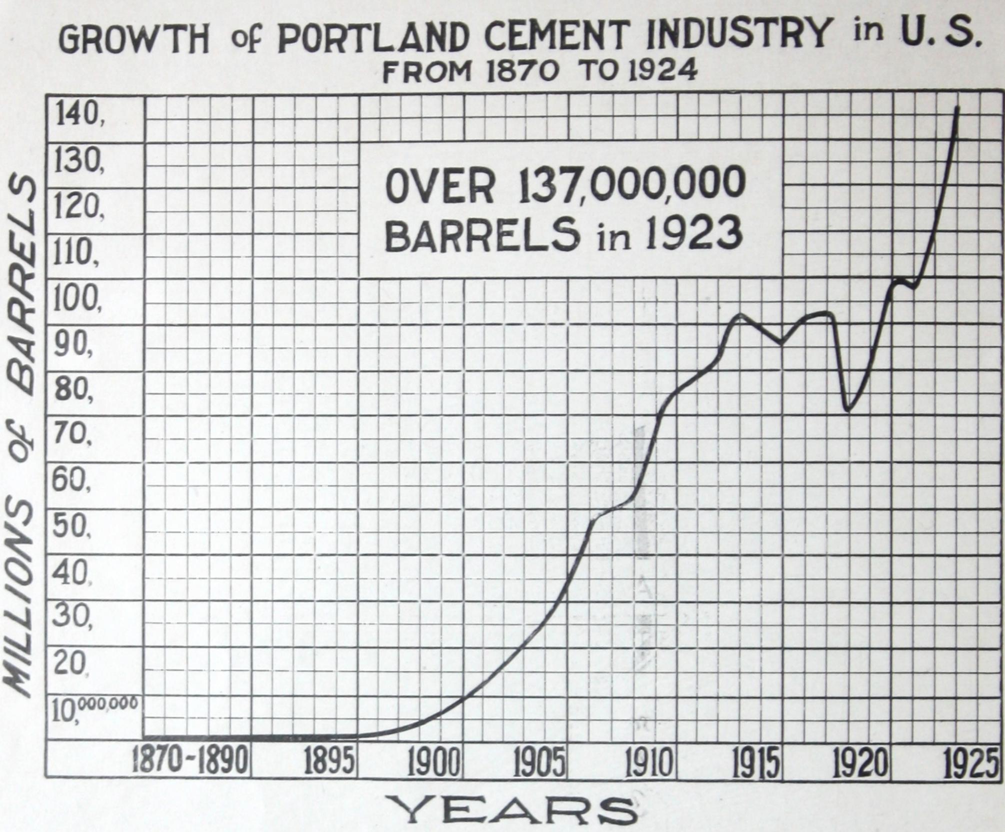


ALPHA PORTLAND CEMENT COMPANY

Easton, Pa   Chicago, Ill., (140 S. Dearborn St.)

NEW YORK	*16 East 43d Street*	BATTLE CREEK, MICH	*Post Building*
BOSTON	*Board of Trade Building*	IRONTON	*Ohio*
PITTSBURGH	*Oliver Building*	PHILADELPHIA	*Harrison Building*
BALTIMORE	*Builders' Exchange*	ST. LOUIS	*1233 Arcade Building*

Printed in U. S. A.



Growth of Portland Cement in America

A LITTLE over fifty years ago the first two Portland Cement plants in the United States were established. Today there are about one hundred and twenty plants in active operation. Cement as an essential commodity is now in the front rank of domestic manufacture.

The chart above, showing the production of Portland Cement in America, indicates that cement manufacture has attained an important position in our industrial life. From 1872 to 1878 the average annual production was 9,000 barrels, and by 1902 it had increased to 17,230,644. By the end of 1923, as shown in the chart, the production had leaped to over 137,000,000 barrels.

Cement is one of the few materials not destroyed when it is used. Mankind, by endeavoring to create comfort, safety, sanitation, beauty and permanence, naturally seeks the use of Portland Cement, and the growth of that material will continue to go on year after year.

INDEX

Cement Construction and Portland Cement

THE WORD "CONCRETE" refers to sand, pebbles, gravel or crushed stone or other hard material such as slag, hard cinder, broken brick, etc., which has been thoroughly mixed with Portland Cement and water and allowed to harden.

Portland Cement is the most tenacious binding material or mortar known. When properly mixed with the other materials named, it binds with a grip that makes the entire mass as hard and imperishable as if it were cut from solid stone. This "manufactured stone" has rapidly become the principal building material, where strength, durability, and protection against fire, water, rats, etc., are essential.

As concrete requires, in addition to cement, only the most commonplace and easily procured materials—sand, stone, and water—and is simply made, being merely mixed thoroughly, cast in place, and allowed to remain in forms until the hardening takes place, cement construction has a wonderful growth. Its earliest general use was in great engineering undertakings—bridges, retaining walls, sea walls, and the like, but now that the advantages of cement work have become universally recognized, a great list of buildings and improvements, ranging from such small constructions as fence posts to the largest factories and warehouses, are being everywhere built "the permanent way."

Why Cement is Called "Portland"

"Portland" is merely a generic name, such as "wrought" as applied to iron, or "Russia" or "sole" as applied to leather. The name was applied to this class of cement because, when Joseph Aspdin, of Leeds, England, discovered in 1824 the method of making the cement, the product had a "fancied though really slight resemblance to the noted oolitic limestone from the Isle of Portland, on the South coast of England." That oolitic limestone, which by the way is used in the London Westminster Cathedral, was known as "Portland Stone"; hence it seemed natural to give the name "Portland Cement" to the new product that made stone resembling Portland Stone.

There are now almost as many different brands of Portland cement as there are brands of flour or lime.

Increase in Use of Portland Cement

Some idea of the widespread increase in the use of Portland Cement may be gained from the fact that 8,482,000 barrels were manufactured in America in 1900, while the present yearly output is over 137,000,000 barrels. The United States at present leads all other countries in production, and cement is produced at many different points—with raw materials that vary according to the section of the country. Clay, limestone, marl, cement rock, etc., are used.

How "ALPHA" Cement is Made

The raw materials for cement-making contain lime, silica, alumina and still other constituents. These materials are excavated, weighed, dried, proportioned with great care, and then ground to a fine powder. This ground raw material is then subjected to an intense heat, over 2700° F., in great rotary kilns, until it is "calcined to incipient

fusion,"—to use the chemist's terms. The clinker formed by this process is again ground—this time to an impalpable powder —so that more than three-fourths of it will pass a screen containing 40,000 meshes to the square inch. This twice-ground and thoroughly burned fine powder is Portland Cement.

The best grade of Portland Cement mixed one part cement and two parts standard sand, gives a tensile strength on "standard tests" of from 350 to 400 pounds in 28 days, which is several times the strength of "natural" cement, the strongest mortar material known up to the discovery of Portland Cement. Moreover, concrete made of Portland Cement continues for months, probably for years, to gain strength. Just how long it continues to grow stronger is not definitely known, but it is sufficient to be assured that properly built cement structures are practically imperishable. They stand fire, water, and wear, eliminate painting and repairing; keep interiors cool in summer and warm in winter, are attractive and sanitary. With so many advantages, it is scarcely to be wondered at that cement construction is increasing by leaps and bounds.

Portland Cement hardens under water as well as out of it; hence it is doubly useful and makes easily possible structures that otherwise would present difficult problems.

"ALPHA" History and Policy

The brand — ALPHA CEMENT — was originally used in 1891 by the Whitaker Cement Company at Bonneville, New Jersey, now Alpha, New Jersey, when first the English Portland Cements and later the German Portland Cements were regarded as being of the best quality.

The Alpha Portland Cement Company, a pioneer manufacturer of American Portland Cement, was organized on April 8, 1895, and two days later a charter was granted to the new company by the state of New Jersey. The newly organized Alpha Portland Cement Company, about the middle of 1895, acquired the property of the Whitaker Cement Company at Alpha, New Jersey. The original equipment was two 40-foot kilns with a yearly output of 100,000 barrels.

During the period beginning December 1, 1895 to November 30, 1896, the first full year in which actual records of the production were kept, there were manufactured 208,544 barrels of ALPHA CEMENT. The original plant at Alpha was increased by 1899 to ten kilns 60 feet long with a capacity of 2,000 barrels daily. In 1901 a second plant was built at Alpha which has a capacity of 4,500 barrels daily. The first of these plants has long since become obsolete and has been abandoned.

In 1902 the Martins Creek Portland Cement Company, Martins Creek, Penna., which had established a mill on the Delaware River about seven miles above Easton, Penna., was purchased, and a second large plant at the same point was acquired in 1905 from the National Portland Cement Company, Martins Creek, Penna. These plants have been so developed that their present daily capacities are 4,500 barrels and 6,500 barrels ALPHA CEMENT.

The plant of the Buckhorn Portland Cement Company at Manheim, W. Va., was purchased in 1909 and now has a daily capacity of 2,500 barrels. In the latter part of 1909, the Catskill Portland Cement Company, Catskill, New York, and in 1917 the plant of the Thomas Millen Company, Jamesville, New York, were purchased. These two plants have present daily capacities of 3,500 barrels and 1,500 barrels of ALPHA CEMENT respectively.

All of these early purchases were confined to mills in the east, but in the latter part of 1920, three plants in the middle west were purchased; namely, The LaSalle Portland Cement Company, LaSalle, Illinois; The Burt Portland Cement Company, Bellevue, Michigan and The Ironton Portland Cement Company, Ironton, Ohio. These three plants have since been improved and at present the LaSalle plant has a daily capacity of 4,500 barrels; the Bellevue plant a daily capacity of 2,500 barrels and the Ironton plant a daily capacity of 3,000 barrels.

In December, 1922, the plant of the Continental Portland Cement Company, Continental, Missouri, which is just seven miles from St. Louis, was acquired. It has been enlarged since the purchase and now produces 4,500 barrels of ALPHA CEMENT daily.

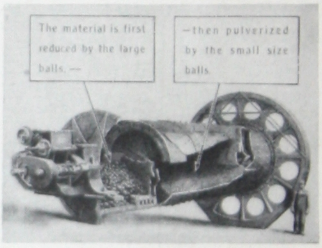
With the acquisition of these plants, the Alpha Portland Cement Company now owns ten plants, strategically located with respect to distribution and the use of cement and serving a territory extending from the

ILLUSTRATED STORY OF A

One of the busy ALPHA CEMENT Plants, Mill No 3 Martins Creek Pa

150,000 Tons of Cement Rock brought down by blast of 15 Tons of Dynamite (oval)

Cement Rock going through Gyratory Crusher

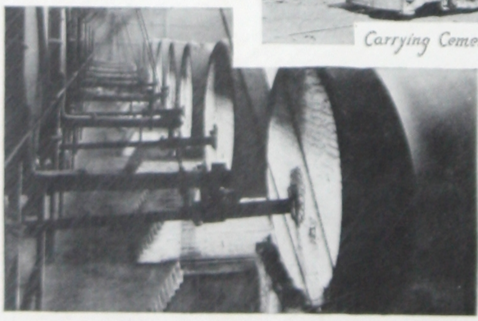


Sectional View of Two-Compartment Mill

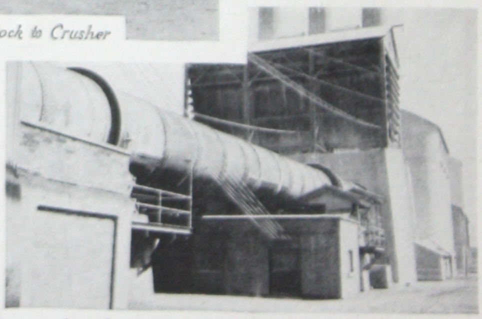
ALPHA Cement Rock Quarry

Carrying Cement Rock to Crusher

Electric Shovel at Work



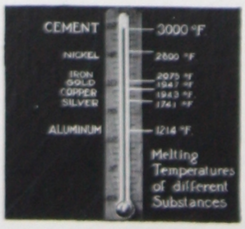
Rotary Kilns where ALPHA CEMENT is burned



Outside Rotary Kiln, La Salle Ill Plant

Cement Rock being carried to Crusher

(Left)

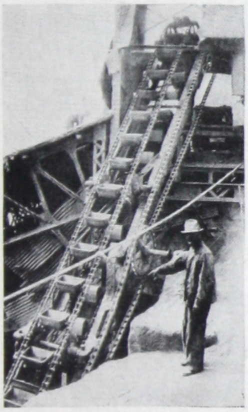


Loading ALPHA CEMENT in boat Cementon, N Y Plant on Hudson River

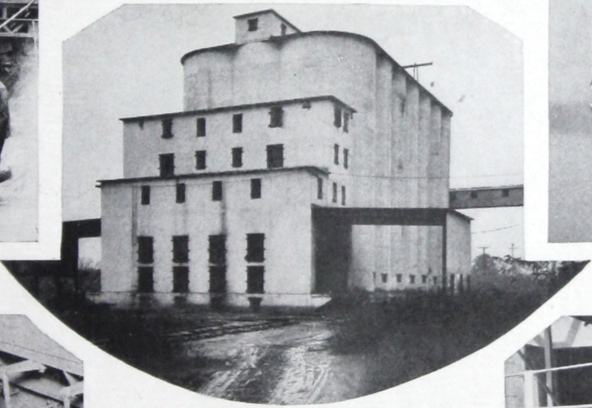
(Right)

BAG OF ALPHA CEMENT

Distributing Clinker in Open Storage by Electric Crane after It Comes from Rotary Kilns. The Same Crane also Conveys the Clinker to the Finishing Mills



Inclined Elevator to carry clinker to Storage



Stockhouse, Ironton Plant, Ironton, Ohio

Testing a Cement Briquette for Strength

ALPHA Cloth Bags are filled through valve in bottom end and contain 94 lbs net

ALPHA Laboratory Scene

ALPHA Bags traveling to loading platform

Cement is ground so fine that it will pass through a Sieve that actually holds water

An Example of Ancient Cement Construction

Nearly four-fifths of any test sample will pass through this Sieve that holds water

Atlantic Seaboard to the Mississippi River. See the map on page 1, showing the location of the ten ALPHA CEMENT mills. From its inception, the Alpha Company has enjoyed a steady growth, both in number of plants operated and capital employed.

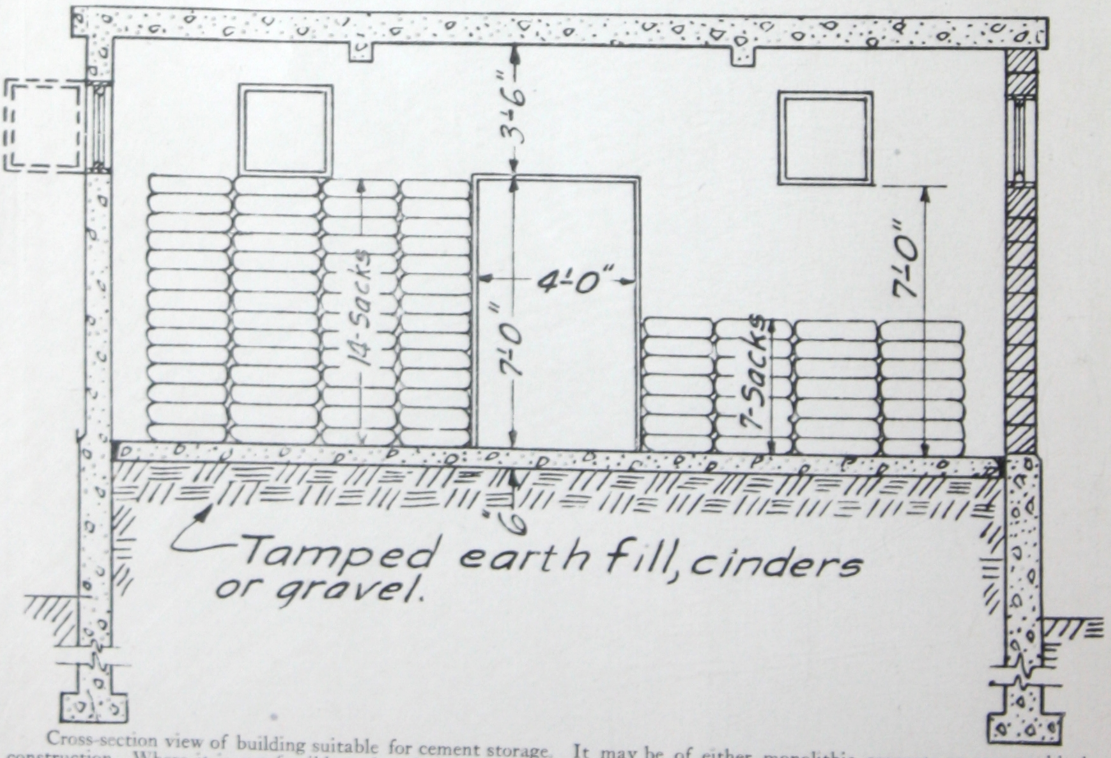
The Alpha Company has always maintained the policy of manufacturing one grade of Portland Cement and to have that of such a quality that it would be a credit to the Company behind the brand. The annual capacity of the Alpha plants has been increased from 100,000 barrels in 1895 to more than 12,000,000 barrels—a daily average of 37,500 barrels at present. Neither sharp competition nor zeal for increased output at low cost has ever been allowed to lower the quality of ALPHA CEMENT. And ALPHA service is kept on a par with the high quality of ALPHA CEMENT.

Experience has shown that the policy of the Alpha Portland Cement Company is correct. More and more the discriminating buyer shows his appreciation of the product of which the standard of quality is invariably high—that can be depended on whether or not the usual tests are applied.

How to Store Portland Cement

Portland cement is usually sold in cotton or paper bags containing 94 pounds net, conveniently considered as one cubic foot, volume measure. For the export trade cement is packed in barrels or drums. For use on larger building operations and in cement product factories it is sometimes sold in bulk. Cotton bags are used a number of times and are bought back by cement manufacturers and dealers when in good condition, thus reducing the package cost to the cement user. Bags which have become wet are unsuited for further use as cement containers and therefore cannot be returned for credit.

Cement can be safely stored almost indefinitely if protected against moisture. With good facilities it is frequently stored for many weeks—occasionally several months—



Cross-section view of building suitable for cement storage. It may be of either monolithic concrete or cement block construction. Where it is not feasible to lay the floor on a gravel or cinder fill, the floor must be reinforced and carried by beams supported by cement piers, and the foundation wall should have openings that will permit free circulation of air beneath the floor. Footings should be to firm foundation below frost line.

without damage to quality. But it must be remembered that cement has a very strong affinity for moisture and even though protected from direct contact with the latter, cement stored where subjected to air currents may soon absorb enough moisture from the atmosphere to affect its strength. In order to keep it in perfect condition cement must be stored where it is not only dry, but secure from drafts as well.

The illustration on page 8 shows a cement storage shed which may be built either of reinforced cement or of cement masonry construction. Doors and windows should be restricted in number and size to barely meet absolute requirements for movement in and out and for light. They should fit tightly and must be kept closed. The cement floor should be placed on a well compacted cinder or gravel fill at proper grade so that the floor surface will be about one foot above the driveway level. If it is desired to place the floor higher, for convenience in unloading and loading, the construction should be carefully designed reinforced work. The floor ordinarily should consist of slabs 6 inches thick, of 1 : 2 : 3 concrete, in order to make it dense. Each sack of cement occupies about 2 square feet of floor area or 1¼ cubic feet, volume measure in the storehouse.

If cement is to be stored in a frame building, roof and walls should be thoroughly inspected to make sure that they are dry and wind-proof. Tar paper applied outside and inside, is probably the cheapest dependable wall covering. That portion of the floor on which the cement is to be stored should be stripped and covered with building paper on which should be placed an additional thickness of tongued and grooved flooring. Rooms or compartments in the storage building should be of moderate size and ceiling height not over 10 feet.

Cement stored for short periods is often piled 12 to 15 sacks high, alternate courses lengthwise and crosswise, to prevent overturning. To prevent caking or "warehouse set," the piles should be limited to seven sacks in height if storage is to be for a period longer than a few days. Piles of cement to be stored over an extended period should be covered with paper as a further protection from drafts, and should not be placed nearer than 1 foot to the side walls.

"Warehouse set" is merely the caking or compacting of the sacked cement when heavy loads are packed upon it. This is remedied by rolling the sacks on the floor. The presence of lumps which do not break up under light rolling indicates permanent injury to the cement by the absorption of moisture. For important work sacks containing such lumps should be discarded. For unimportant or mass work sacks containing lumps may be used after the latter have been screened out.

Cement cannot be safely stored on the ground. Even during the progress of construction work in which it is being used, cement should be piled on board mats, canvas, building paper or similar material. If piled in the open, tarpaulins sufficient to entirely cover the pile must be available for use over night and in case of rain.

"How to Store Cement" is the title of a bulletin published by the Portland Cement Association. It explains in detail the proper methods of storing cement in sacks and will be mailed to you free of charge upon request.

Large contractors and others interested in the economical handling of cement in bulk may receive a copy of the Association's booklet "Bulk Cement" with latest information on the subject.

Returning Cement Sacks

Cotton cement sacks are one of the few containers of common necessities which may be returned (if in usable condition), for credit. When the return feature of the cloth sack is considered, it is an extremely economical package. As cement sacks are filled an average of about eight times before they become unfit for service, an average of at least seven out of every eight sacks received by the user can be returned for credit if carefully handled, stored and bundled for safe return transit. Thus, where the user pays a sack deposit or service charge of 10 cents per sack, if he returns seven out of every eight sacks the net cost of the package to him is 1¼ cents per sack. Moisture ruins and tearing greatly damages cloth sacks and users should beware of both. Cement sacks are too costly to use for other purposes and should always be returned for credit as soon as convenient. Paper sacks ordinarily cost the user more, but many prefer the paper package because it need not be preserved after use.

Materials, Proportioning, Mixing and Placing

GOOD cement is necessary to make good concrete. But Portland Cement, no matter how good, cannot make good concrete unless mixed with sand, pebbles, broken stone or similar materials that are suitable.

ALPHA CEMENT is uniform, meeting the most severe engineering and other specification requirements, thus relieving the user of any concern in that direction.

On the average, cement probably constitutes about one-fifth of the bulk of concrete. The "aggregates"—sand, pebbles, gravel or stone—make up the other four-fifths. For best results these materials must be acceptable as regards cleanness, gradation and durability. In the following tests, suggested to determine the qualities of sand or gravel it is very important that representative samples be used. If aggregates are found to vary quite noticeably in various parts of the supply, a number of samples, perhaps five or six, should be taken.

Cleanness. Two tests are available for determining the cleanness of aggregates. The silt test indicates the relative amount of harmful fine matter, such as clay and silt, which may be present. The colorimetric test determines the presence of humus or other organic matter which is injurious to strength. Fortunately these tests are both quite simple to understand and to perform.

The Silt Test. The relative amount of excessively fine material in a sample of aggregate may be found by placing it in a 32-ounce graduated bottle, so that the dry material reaches the 14-ounce mark. Water is added until water and aggregate occupy the space up to the 28-ounce mark. The bottle is then shaken vigorously for one minute. The sediment is allowed to settle until the water is clear. If the layer of sediment deposited on the sand is greater than one ounce, as indicated by the graduations on the bottle, the material should be washed before using in concrete work.

The Colorimetric Test. Organic impurities are even more dangerous to the strength of concrete than is excessively fine matter. The colorimetric test, as developed at the Structural Materials Research Laboratory, Lewis Institute, and recently adopted by the American Society for Testing Materials, may be depended upon to indicate the presence of organic matter in the sand, with the exception of certain rare deposits of lignite. Small but harmful quantities of impurities are seldom discovered by visual inspection.

The colorimetric test is performed by filling a 12-ounce graduated prescription bottle to the 4½-ounce mark with the sand to be tested. A 3 per cent solution of sodium hydroxide is then added until the volume of sand and solution, after shaking, amounts to 7 ounces. The contents of the bottle is shaken thoroughly and let stand from 12 to 24 hours. If the solution resulting from this treatment is colorless, or has a milky or a light yellowish color, the sand may be considered sufficiently free from organic impurities for any use. If the solution is darker than a straw color the sand is unsuited for important concrete work such as roads, pavements and building construction. If the solution appears brownish throughout (darker than plate 3 of the accompanying chart) it is not suited for any kind of concrete work and should not be used.

The sodium hydroxide (ordinary caustic soda) required for the solution may be obtained from any drug store. An ounce of sodium hydroxide in stick or pencil form dissolved in pure water will make 32 ounces of the 3 per cent solution required for this test.

Gradation of Materials. Ideally graded material for cement work contains particles varying in size from fine to the coarsest which can be used. Greater strength and better wearing qualities are obtained with less cement by the use of a preponderance of coarse particles, with only sufficient of the smaller sizes to fill up the intervening spaces, thus obtaining greater density and watertightness and smoother surface texture.

A given volume of coarse particles has less surface area than the same volume of smaller particles. Therefore less cement and water "paint" is required to coat the surface of a given volume of coarse particles

COLORIMETRIC TESTS FOR SANDS

[DESCRIBED ON PAGE 10]

1 — 2: Sands suitable for use in high-grade concrete.

2 — 3: Sands which may be used in unimportant concrete work.

3 — 4: Sands which should never be used in concrete.

4 — 5: An unusually bad sand, soil or loam.

COLORS OF TREATED SANDS WITH SUGGESTED RANGES OF APPLICATION

ALPHA CEMENT — HOW TO USE IT

FIG. 1 Sand filling voids of large stone

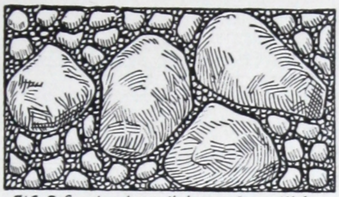


FIG. 2 Sand and small stone mixed with large

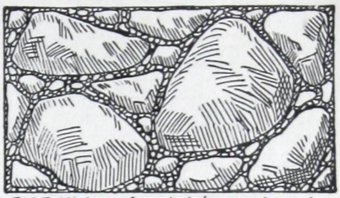


FIG. 3 Mixture of graded stone and sand.

than is required for the same volume of fine particles. A mixture of one part cement to five parts well graded aggregate frequently develops greater strength than one part cement to three parts of fine sand.

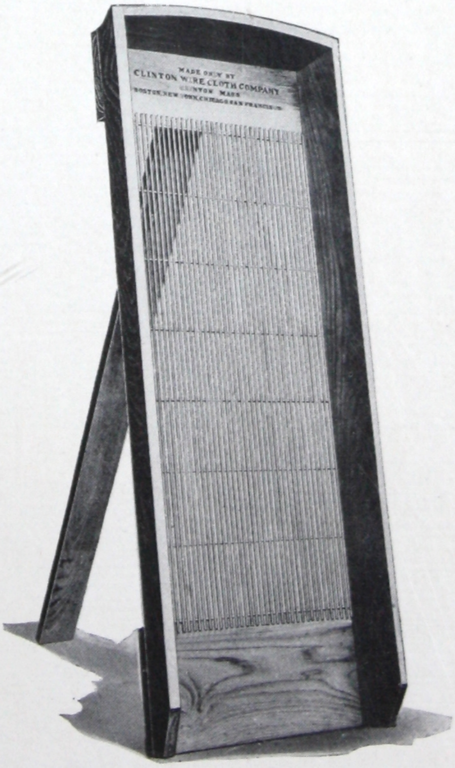
Only occasionally nature has provided gravel properly graded for most efficient use in concrete. Therefore, the practice has been well established of screening out the "sand" or material finer than ¼ inch from the "pebbles" or material coarser than ¼ inch, so that the two may be recombined in definite proportions. Commercial producers of these materials furnish sand and pebbles screened and washed, as required.

"Bank run" gravel may be separated into "sand" and "pebbles" by shoveling it over a screen having meshes ⅜-inch apart, set at an angle of sixty degrees with the ground. Owing to the angle at which the gravel strikes the screen, and the tendency for even dry sand to clog the corners of the screen somewhat, such a screen will be found to divide the material at approximately the ¼-inch size. For contractors and others using the screen frequently, the type shown in the accompanying illustration is recommended. It consists of large rods with clear spaces ⅜-inch wide between, electrically welded to horizontal support rods.

Sand. The coarse graded sand required for economical use in concrete is not to be confused with fine sand used for plastering and sand blasting. Not more than 6 per cent of concrete sand should go through a 100 mesh sieve (having 100 openings to the linear inch in each direction) and the greater part of it should be coarser than the 50 mesh sieve. Crushed stone screenings, if free from dust and dirt, will be found about equally acceptable with sand of similar gradation. Screenings almost always contain more or less dust, however, and for this reason are generally considered inferior to sand.

Pebbles. Pebbles, or screened gravel as commonly known, may be used in as large proportions as possible without producing rough or unsightly surfaces or lack of sufficient density. Broken stone of similar gradation may be used almost interchangeably with screened gravel, but for most uses the latter is preferred at the same cost, for its smoother working qualities. The largest size pebbles, broken stone or similar material permitted must not exceed in greatest dimension one-half the thickness of the section in which used.

In very thick walls, such as foundations, dams and other massive work, large rock or field stone can be safely used, provided they are clean, damp, and so placed as to be entirely surrounded by concrete.



Modern type of sand screen which separates damp material almost as efficiently as that which is thoroughly dry

ALPHA CEMENT — HOW TO USE IT

Recommended Mixtures and Maximum Aggregate Sizes

	Cement	Sand	Pebbles or Stone	Maximum Size of Particles in Inches
Alley pavement (one course)	1	2	3	3
Alley pavement (base of two course)	1	2½	4	3
Back plastering of walls	1	1½	–	*
Barn floors, gutters, mangers (one course work)	1	2	3	1
Barnyard pavements (one course work)	1	2	3	1½
Barnyard pavements (base, two course work)	1	2½	5	1½
Barnyard pavements (wearing course, two course work)	1	2	–	¼
Basement floors—see Floors				
Basement walls and pits (watertight construction)	1	2	3	1½
Basement walls and piers where watertightness is not essential	1	2½	5	2
Bridge abutments and wing walls	1	2½	5	2
Building walls above foundation where stucco finish will not be applied	1	2½	4	1½
Building walls to be covered with stucco	1	2½	5	1½
Cement building block (backing)	1	2½	4	¾
Cement building block (surfacing)	1	2½-3	–	¼
Cement brick	1	4	–	⅜
Cisterns	1	2	3	1
Coal pockets	1	2½	4	1½
Columns (reinforced building)	1	2	3	1
Culverts	1	2½	5	2
Dams and small retaining walls	1	2½	5	2
Dipping vats	1	2½	4	1
Elevator pits	1	2	3	1
Engine foundations	1	2½	5	2
Facings for concrete products	1	2½-3	–	¼
Feeding floors—see Floors.				
Fence posts	1	2½	2	½
Fence posts (when coarse aggregates not used)	1	3	–	¼
Floors (one course work)	1	2	3	–
Floors (base, two course work)	1	2½	5	1½
Floors (wearing course, two course work)	1	2	–	¼
Floors (wearing courses subject to heavy trucking, as in factories, warehouses, loading platforms, etc.)	1	1	1½	½
Flower boxes	1	2½-3	–	¼
Foundations and footings (heavy)	1	3	6	3
Gate posts	1	2½	4	¾
Grain bins, tanks and elevators	1	2½	4	1½
Hog wallows	1	2½	4	1
Hot beds	1	2½	5	1½
Inside finish for tanks, silos, bins and facing for building walls below ground where necessary	1	1½	–	*
Manure pits	1	2½	4	1½
Mass concrete for footings, etc.	1	3	6	3
Milk cooling tanks	1	2	3	1
Mine timbers	1	2	3	¾
Ornamental products (backing)	1	2½	4	¾-1
Ornamental products (surfacing)	1	2½-3	–	¼
Pickling vats	1	2	3	1
Porch floors and steps (backing)	1	2	3	1½
Reservoirs	1	2	3	1
Retaining walls (small)	1	2½	5	2
Roof slabs (reinforced)	1	2	3	1
Roads (one course)	1	2	3	3
Roads (base of two course)	1	2½	4	3
Scale pits	1	2½	4	1½
Septic tanks	1	2	3	1½
Sills and lintels without mortar surface	1	2	3	¾
Silo walls	1	2½	4	1½
Stairs and steps (backing)	1	2½	4	1
Stairs and steps (surfacing)	1	2½	–	¼
Storage tanks for water	1	2	3	1½
Streets (one course)	1	2	3	3
Streets (base of two course)	1	2½	4	3
Stucco-scratch coat	1	2½	–	*
Stucco—intermediate and finish coats	1	3	–	*
Troughs and watering tanks	1	2	3	1
Vats	1	2	3	1
Walks (one course work)	1	2	3	1½
Walks (base, two course work)	1	2½	5	1½
Walks (wearing course, two course work)	1	2	–	¼
Well linings	1	2	3	1

* Maximum size must pass through No. 8 screen.

ALPHA CEMENT — HOW TO USE IT

Durability of Aggregates. Cement construction can hardly be strong if made of weak materials. Therefore such soft materials as shale, slate, and other rock which crumbles, slivers or peels off, should be avoided. Most gravel will be found dependable, so far as durability is concerned, as will also granite, trap rock and most limestone. There is a wide variation in the hardness of slag, owing to the varying conditions under which it is produced. Hard and generally acceptable slag is available for cement work in many localities.

Cinders for Concrete.—Cinders may be used where lightness is more desirable than strength. Cinders are light and porous, and are considerably more friable or crumbly than the other aggregates. The principal advantages of cinder concrete are that it is a poor conductor of sound and heat, that it has lightness, fireproofness, is easily cut and sufficiently soft to allow nails to be easily driven into it. Cinders from plants that maintain high temperatures in their furnaces are more desirable, as they, as a rule, are fused to a clinker and are free from fine material. Ashes from anthracite coal or wood are undesirable as they do not fuse to a clinker, but are reduced to a fine flake-like ash and will produce a very weak and brittle concrete. Cinder concrete is very frequently used for the floors of tall buildings and in the manufacture of cement products such as building block and brick. Cinder aggregates absorb more water in the mixing than do gravel or broken stone. Concrete made with cinders is usually placed with minimum ramming in order not to crush the particles, thereby increasing the area to be covered by the cement.

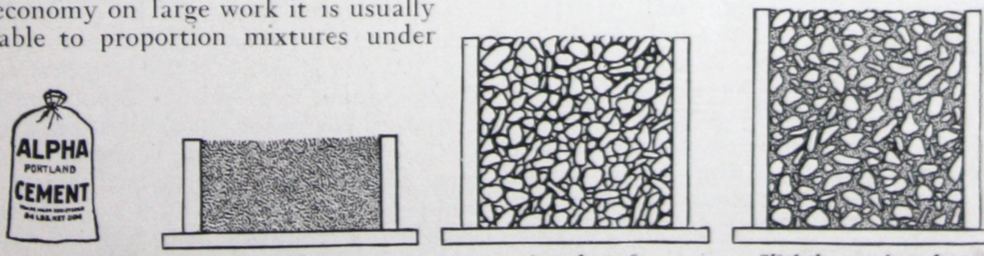
Proportioning. Concrete is usually proportioned by volume. For extreme precision and economy on large work it is usually advisable to proportion mixtures under the guidance of laboratory tests, in which the gradation of the aggregates, amount of water to be used and other factors are taken into consideration. For most cement work, however, experiments and practical use have proven suitable the arbitrary mixtures indicated in the table given on page 12.

The proportions indicated are to be used in measuring by volume. One part cement to 2 parts of sand and 3 parts of screened gravel (pebbles), for example, may be proportioned for a "1-sack batch" by taking 1 sack (which is 1 cubic foot) of cement, 2 cubic feet of sand and 3 cubic feet of screened gravel (pebbles). The resulting volume, as shown in Table 1, page 15, column 6, is 3.9 cubic feet. Similarly, a 1 sack batch of 1:2½:5 concrete would require 1 sack of cement, 2½ cubic feet of sand and 5 cubic feet of screened gravel (pebbles) or crushed stone. The resulting volume would be 5.4 cubic feet.

The three right-hand columns of Table 1 provide information as to the quantities of materials necessary for 1 cubic yard of mortar or concrete. Thus, 1 cubic yard of 1:2:3 concrete will require 7 sacks of cement (column 7), 14 cubic feet of sand (column 8) and 21 cubic feet of screened gravel (pebbles) or crushed stone (column 9).

Mixing Water

It is only recently that the influence of the amount of mixing water on the strength of concrete has been fully understood. Water is more than a mere lubricant, as often considered. It is the ingredient with which the cement reacts. Too little water is as bad as too little cement, for a shortage of water in the mixture means that some of the cement cannot be taken advantage of. Likewise too much water is likely to "drown" some of



1 bag of CEMENT (about 1 cu. foot) | 2 cu. feet of SAND | 4 cu. feet of STONE | Slightly over 4 cu. feet of CONCRETE

Illustration of a 1:2:4 mix. Note that as the sand merely fills the voids of the stone and the cement fills the voids of sand, the seven cubic feet of material make a batch of only a little over 4 cubic feet of concrete. Beginners in cement construction often err in thinking that the volume of the concrete will equal the total volume of materials used.

the cement, greatly reducing its usefulness; excessive water often drains off, carrying cement with it. It has been definitely proven that for every concrete mixture there is a certain amount of water which gives greatest strength; a little more or a little less water than this amount results in a considerable reduction in strength and often in blemished surfaces.

Table 6 is given as a guide to the approximate amount of water required for one sack batches of various commonly used mixtures. Any deviation found in the consistency or relative plasticity of various batches to which identical quantities of water have been added may be charged to varying amounts of moisture in the aggregate supply before the measured quantity of mixing water is added. See page 17, "The Slump Test."

How to Figure Amounts of Materials

The first step in calculating quantities is, of course, to figure the total cubic space to be occupied by the concrete, which is learned by the simple method of reducing the dimensions to like units of measurement; for example, having all dimensions, feet or fractions of feet, and multiplying breadth and thickness together. For example, if a floor or driveway is to be 30 feet long by 12 feet wide and 6 inches thick, we have 30 by 12 by ½ equals 180 cubic feet, which divided by 27, the number of cubic feet to the yard, gives 6-2/3 cubic yards of volume.

Figuring a Foundation. A foundation that is to be 1 foot thick, 10 feet high, 25 feet wide and 40 feet long would be figured as 1 by 10 by 23 equals 230 for the short wall and 1 by 10 by 40 equals 400 for the long wall. The reason for using 23 as the building length of the short wall is that if the long wall is figured the full length, its thickness will of course lessen the length of the short wall one foot at each end. As there are two short walls and two long ones, the totals of 230 and 400 would be double, giving 1260 cubic feet, from which should be deducted space occupied by doors and windows.

Amounts of Cement, Sand and Stone. The simplest rule for mixing a batch of concrete is to take the proportions as a table of cubic feet. Thus, if the proportion is 1:2½:5, use 5 cubic feet of stone, 2½ of sand and 1 of cement.

Table 1 will be found very useful in calculating the quantities of sand and gravel, or stone, required for a one-bag batch of mortar or concrete, and in computing the volume of the resulting mortar or concrete. It will be found equally valuable in finding the quantities of material required per cubic yard of concrete.

It will be observed from Table 1, that the volume of finished concrete will overrun slightly when the rule is followed of using the same number of cubic yards of stone as there are cubic yards of volume in the job to be undertaken. Thus, when five yards of stone are used in a 1:2½:5 mixture the table gives the result of 5.4 yards of finished concrete. This difference comes mainly because the amount of sand used is slightly in excess of actual voids.

Example of Use of Table 1

If 100 cubic yards or 2700 cubic feet of volume are to be filled with concrete of a 1:2½:5 mixture, the quantity of cement required is found by referring to column 7, following it down to the ninth figure from the top (in the horizontal 1:2½:5 line) which indicates that 5 sacks of cement are required per cubic yard, therefore 500 sacks (125 barrels) for 100 cubic yards of 1:2½:5 concrete.

Similarly, by reference to column 8, it is found that 12½ cubic feet of sand is required per yard of concrete, or 1250 cubic feet, equal to 46.3 cubic yards, for 100 cubic yards. Column 9 is used in the same manner to obtain the stone required, which is just twice the amount of sand, 2500 cubic feet or 92.6 cubic yards.

Or, the calculation may be reversed. To find the number of one-sack batches required for 100 yards of 1:2½:5 concrete follow down column 6 to the corresponding horizontal, indicating that each one sack batch of this particular mixture occupies 5.4 cubic feet. Then the number of batches required will equal 2700 divided by 5.4 or 500. Since each batch requires 1 sack, 500 sacks are required for the entire work. Columns 3 and 4 indicate sand and stone required by each batch, each figure as given being multiplied by 500.

ALPHA CEMENT — HOW TO USE IT

*TABLE 1

QUANTITIES OF MATERIAL REQUIRED FOR VARIOUS MIXTURES OF MORTAR AND CONCRETE

	Quantities of Materials for a One-Sack Batch			Volume in Cubic Feet of a One-Sack Batch		Quantities of Materials for 1 Cu. Yd. of Compacted Mortar or Concrete		
Mixture (1)	(2) Cement in Sacks	(3) Sand Cu. Ft.	(4) Pebbles or Stone Cu. Ft.	(5) Mortar	(6) Concrete	(7) Cement in Sacks	(8) Sand Cu. Ft.	(9) Pebbles or Stone Cu. Ft.
1:1½	1	1½	...	1.75	...	15½	23	...
1:2	1	2	...	2.1	...	12¾	25½	...
1:2½	1	2½	...	2.5	...	11	27½	...
1:3	1	3	...	2.8	...	9½	28¾	...
1:1:1½	1	1	1½	...	2.3	12	12	17¾
1:2:3	1	2	3	...	3.9	7	14	21
1:2:4	1	2	4	...	4.5	6	12	24
1:2½:4	1	2½	4	...	4.8	5½	14	22½
1:2½:5	1	2½	5	...	5.4	5	12½	25
1:3:6	1	3	6	...	6.4	4¼	12½	25

TABLE 2

QUANTITIES OF MATERIALS REQUIRED FOR LINEAR FOOT OF CEMENT PAVING FOR THE WIDTHS AND THICKNESSES AT SIDES AND CENTER AS SHOWN

Width (feet)	Thickness Side and Center (inches)	CEMENT (bbl.)		SAND cu. yd.		Rock or Pebbles cu. yd.	
		1:2:3	1:1½:3	1:2:3	1:1½:3	1:2:3	1:1½:3
9	6-7	0.32	0.35	0.10	0.08	0.14	0.16
16	6-8	0.63	0.68	0.19	0.15	0.28	0.30
18	6-8	0.71	0.77	0.21	0.17	0.32	0.34
20	6-8½	0.82	0.90	0.24	0.20	0.36	0.40
24	6-9	1.01	1.10	0.30	0.24	0.45	0.49

Quantities based on the assumption of 45% voids in the coarse aggregate.

TABLE 3

MATERIALS REQUIRED FOR 100 SQ. FT. OF SURFACE FOR VARYING THICKNESS OF PLASTER

Proportions	1:1		1:2		1:2½		1:3	
Thickness (in.)	Cement (sacks)	Sand (cu. yd.)	Cement (sacks)	Sand (cu. yd.)	Cement (sacks)	Sand (cu. yd.)	Cement (sacks)	Sand (cu. yd.)
⅜	2.2	0.08	1.5	0.11	1.3	0.12	1.1	0.13
½	3.0	0.11	2.0	0.15	1.7	0.16	1.5	0.17
¾	4.5	0.16	2.9	0.22	2.5	0.23	2.2	0.25
1	6.0	0.22	3.9	0.29	3.3	0.31	3.0	0.33
1¼	7.5	0.27	4.9	0.36	4.2	0.39	3.7	0.41
1½	9.0	0.33	5.9	0.43	5.1	0.47	4.5	0.50
1¾	10.5	0.39	6.9	0.50	6.0	0.56	5.4	0.60
2	12.0	0.45	7.9	0.58	6.9	0.64	6.2	0.69

If hydrated lime is used it should be added in amounts of from 5 to 10% by weight of the cement.
Hair is used in the scratch coat only in amounts of ⅛ bushel to 1 sack of cement.
These figures may vary 10% in either direction due to the character of the sand.
No allowance is made for waste.

*Tables 1 to 6 inclusive, on pages 15 and 16, are intended to cover general concreting practice. Additional useful tables are given as follows: Maximum Allowable Slump, page 18; Areas of Round and Square Reinforcing Rods, page 27; Materials for Cement Stucco, page 50; Recommended Coloring Materials, page 50; Dimensions of Silos, page 87; Dimensions of Septic Tanks, page 93.

TABLE 4

MATERIALS REQUIRED FOR 100 SQ. FT. OF SURFACE FOR VARYING THICKNESS OF COURSE

Thickness	1 in.			2 in.			4 in.			5 in.		
Mix	Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone
1:2	3.9	0.29	....	7.9	0.58	....	....	....	....	....	....	....
1:1:1	4.2	0.15	0.15	8.3	0.31	0.31	....	....	....	....	....	....
1:1:1½	3.7	0.14	0.20	7.3	0.27	0.41	....	....	....	....	....	....
1:1½:2½	2.6	0.14	0.24	5.1	0.28	0.47	....	....	....	....	....	....
1:1½:3	....	....	....	....	....	....	9.4	0.52	1.04	11.7	0.65	1.30
1:2:3	....	....	....	....	....	....	8.6	0.64	0.95	10.8	0.80	1.19
1:2:4	....	....	....	....	....	....	7.4	0.55	1.10	9.3	0.69	1.37
1:2½:4	....	....	....	....	....	....	6.9	0.64	1.02	8.6	0.80	1.27
1:2½:5	....	....	....	....	....	....	6.2	0.57	1.14	7.7	0.72	1.43
1:3:6	....	....	....	....	....	....	5.2	0.58	1.16	6.5	0.73	1.45

Thickness	6 in.			7 in.			8 in.			9 in.		
Mix	Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone
1:1½:3	14.0	0.78	1.56	16.4	0.91	1.82	18.7	1.04	2.08	21.1	1.17	2.34
1:2:3	12.9	0.95	1.43	15.0	1.11	1.67	17.2	1.27	1.90	19.3	1.43	2.14
1:2:4	11.1	0.82	1.64	12.9	0.96	1.92	14.8	1.10	2.19	16.7	1.23	2.47
1:2½:4	10.3	0.95	1.53	12.0	1.11	1.78	13.8	1.27	2.03	15.5	1.43	2.29
1:2½:5	9.2	0.86	1.72	10.8	1.00	2.00	12.3	1.14	2.29	13.9	1.29	2.57
1:3:6	7.9	0.87	1.74	9.2	1.02	2.03	10.5	1.16	2.32	11.8	1.31	2.61

NOTE. Quantities expressed in the following units:
Cement . . . sacks; Sand . . . cubic yards; Pebbles or broken Stone . . . cubic yards.

TABLE 5

MATERIALS REQUIRED FOR 100 SQ. FT. OF SIDEWALKS AND FLOORS FOR VARIOUS MIXTURES AND THICKNESS OF COURSES

Thickness of Course in Inches	Wearing Course				Base Course								
	1:1½		1:2		1:2:3			1:2½:4			1:2½:5		
	Cement	Sand	Cement	Sand	Cement	Sand	Stone*	Cement	Sand	Stone*	Cement	Sand	Stone*
½	2.4	0.13	2.0	0.15	....	....	....	....	....	....	....	....	....
1	4.8	0.26	3.9	0.29	....	....	....	....	....	....	....	....	....
1½	7.2	0.40	5.9	0.43	....	....	....	....	....	....	....	....	....
2	9.6	0.53	7.9	0.58	....	....	....	....	....	....	....	....	....
3	....	....	....	....	6.5	0.48	0.72	5.2	0.48	0.77	4.6	0.43	0.86
4	....	....	....	....	8.6	0.64	0.95	6.9	0.64	1.02	6.2	0.57	1.14
5	....	....	....	....	10.8	0.80	1.19	8.6	0.80	1.27	7.7	0.71	1.43
6	....	....	....	....	12.9	0.96	1.43	10.3	0.95	1.53	9.2	0.86	1.72

Quantities of cement are expressed in sacks, aggregates in cubic yards.
* Stone is used to include screened gravel (pebbles) or broken stone.

TABLE 6

VOLUME OF WATER TO USE

Mix		Approximate Mix as Usually Expressed			Water Required (Gallons per sack of cement)	
Cement	Volume of Aggregate after Mixing	Cement	Aggregate		Minimum	Maximum
			Fine	Coarse		
1	3	1	1¼	2½	5	5½
1	4	1	1½	3	5½	6
1	4½	1	2	3	5¾	6¼
1	5	1	2	4	6	6½
1	6½	1	2½	5	7¼	7¾
1	7¾	1	3	6	8¼	8¾

Finally, remember always to use the smallest quantity of mixing water that will produce a workable mix.

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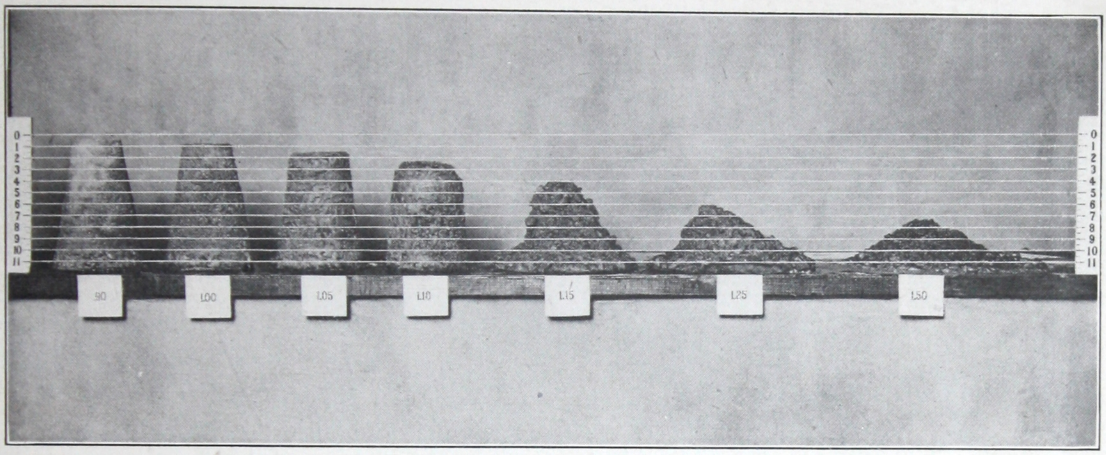
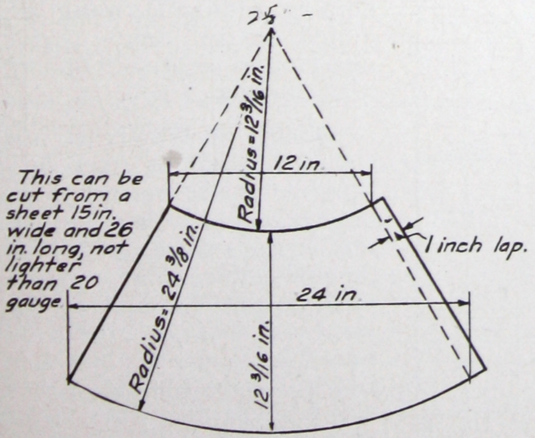


Slump test specimens made with varying proportions of water from .9 to 1.5 show "slumps" ranging from ½ inch to 7¼ inches. The original height of the specimens was 12 inches

Accurate Control of Consistency

The Slump Test. While the columns referring to amount of water, in Table 6, will be found very useful, a more exact method of determining the proper amount of mixing water to use is provided by the "slump" test. It is not difficult to perform and requires only simple apparatus.

Accompanying illustrations give dimensioned plan and views of the small sheet metal form and the ⅝-inch pointed metal rod 21 inches in length, which are the only pieces of apparatus required. The form, which is cut from a piece of No. 20 gauge or heavier galvanized sheet metal, makes up into the shape of the frustrum of a cone 4 inches in diameter at the top, 8 inches at the bottom and 12 inches high. It may be made to order quickly in any tin shop.



Dimensioned sketch for making pattern for slump test mold

The form is filled with concrete to be tested, in layers 4 inches deep, each layer being rodded exactly 10 times, or a total of 30 roddings for the complete filling of the

Interesting steps in making the slump test. Above, carefully withdrawing mold from the specimen. Below, measuring the slump.

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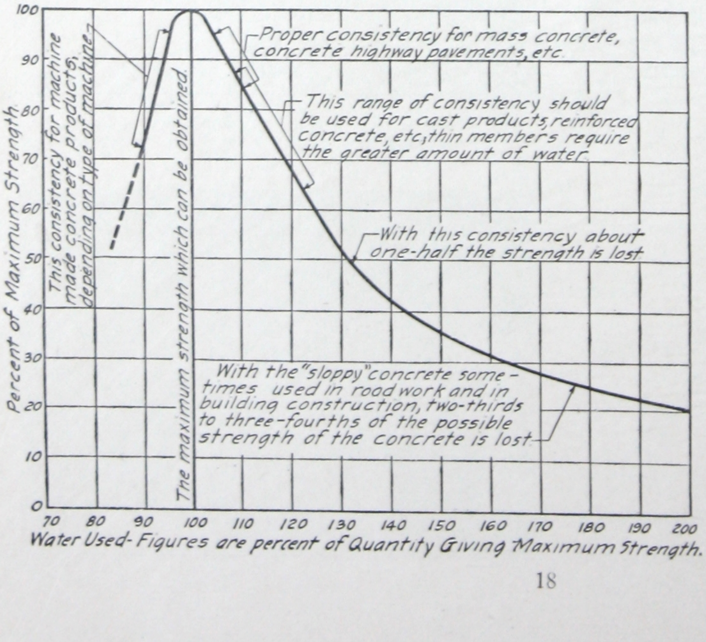
form. The latter is then lifted off with a steady vertical pull, and the settlement of the concrete measured. Before the concrete "slumps" it has a height of 12 inches, equal to that of the form. A slump of from ½ inch to an inch indicates what is known as a relative consistency of 1.00, only a little more water than necessary for maximum strength. A pile of concrete of this consistency can be identified readily in the accompanying illustration of slump test specimens.

Concrete containing 10 per cent less water (having a relative consistency of .90) has scarcely any slump. Concrete containing 10 per cent more water, with a relative consistency of 1.25, containing 25 per cent excess water, slumps 6 to 7 inches and that with a consistency of 1.50 slumps 8 to 10 inches. The latest Progress Report of the Joint Committee on Concrete and Reinforced Concrete recommends the following maximum slumps:

Maximum Allowable Slumps

Mass Concrete	2 inches
Reinforced Concrete:	
Thin vertical sections	6 inches
Heavy sections	2 "
Thin confined horizontal sections	8 "
Roads and Pavements:	
Hand finished	4 inches
Machine finished	1 "
Mortar for floor finish	2 "



It will be observed that, while maximum strength from any given mixture can be obtained only when the relative consistency is approximately 1.00, still somewhat varying amounts of water are necessary to facilitate various methods of handling the concrete. When necessary to use a mix that is too dry, put in all the water possible; when necessary to employ wet mixtures, cut down the water content to as great an extent as possible. It is an almost startling revelation that each excess pail of mixing water may decrease the strength of concrete as much as if one-fourth to one-third of the cement had been left out.

Mixtures for Tamping and Pressure Processes. Cement block, building tile, brick and other products made on heavy tamping or pressing machinery, and cement sewer pipe and drain tile made by a rotary trowelling or pressure (packer head) process, are good examples of cases where mixtures must contain less water than that indicated as the ideal consistency.

Sufficient water may and should be used in such mixtures, however, so that web markings appear slightly on the sides of the products, indicating that moisture has been flushed to the surface in the process. The range of consistencies considered as representing present practice are indicated on the accompanying water curve diagram, from which it will be noted that machine-made products use 75 to 95 per cent of the quantity of water recommended for greatest strength. In almost all such cases at least 85 per cent of the desirable quantity can be used with same machine speed, nothing additional being required except more careful watching to secure uniformity of operations.

Quality of Water. It has come to be almost an axiom, that water fit for concrete must be pure enough to drink. While this is a good standard, it is probably somewhat exaggerated, for no harmful results worthy of mention are known to follow the use of any water which is reasonably clear and free from alkali or commercial acid solutions.

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Cement, sand and pebbles have been turned over together dry; now water will be added and the mass mixed until uniform throughout

Methods of Mixing

Good concrete can be made by hand mixing, but unless laborers are carefully watched and instructed as to the best way of turning materials, imperfectly mixed concrete is likely to result. Machine mixing is more dependable, especially in the batch type of mixer. These come in almost any desired capacity and are relatively low in cost. Many cement and building material dealers rent such mixers to their cement customers, and often farmers join in groups and buy power mixers.

Mixers of the batch type are preferable since measured materials must be put in the drum for each batch, while in the continuous type of mixers there is always possible some variation in moisture content or proportions of materials that may cause the concrete to lack uniformity.

Length of Time in Machine Mixers. Often concrete has been mixed for too short a period of time. Most mixer manufacturers recommend the number of revolutions per minute at which the drum of their machines should be revolved for best results. Whether mixed by hand or machine, mixing should continue until the mixture is of uniform color and consistency. As a general rule, no batch of concrete which is machine mixed should be removed from the drum until mixing has continued for at least one minute. In most cases no mentionable loss of time would result from mixing each batch two minutes, which would give considerably greater strength to the resulting concrete.

Working Methods in Hand Mixing. For measuring materials a bottomless box or frame of 1 or 4 cubic feet capacity should be placed on a board, filled to the required level, and lifted off. Mixing by means of shovelfuls or wheelbarrow loads is uncertain. A frame that holds 4 cubic feet, should be marked on the inside at various levels to indicate 1, 2 and 3 cubic feet.

A platform 8 by 14 feet made of tongued and grooved $1\frac{1}{2}$ or 2-inch stuff so that tight joints will result, is necessary for hand mixing. A strip nailed around the outer edges on three sides will prevent the loss of cement that might be carried away when adding mixing water. Square-pointed shovels are necessary for turning the materials on the board. A sprinkling can, or hose with nozzle, a water barrel, measuring box, wheelbarrows, tampers, spading tools, a wood float, screen, steel trowel and possibly a groover and edger, are about all the tools needed.

In mixing a one-bag batch by hand in the porportions of 1:2:4, first spread out the two cubic feet of sand on the board. Distribute one bag of cement over the sand

as evenly as possible. Then with shovels, turn this material thoroughly, first dry and then wet, applying the water evenly. Now spread this mortar out and place the four cubic feet of stone on top.

The turning process must be resumed and continued until the mass is thoroughly mixed. It is better to err in the direction of turning the material too often than to fail to mix well enough. Streaks of cement indicate that the mixing is not thorough. It is better to keep the pile of stone wet beforehand, so it will already have absorbed some water. The method here described is not the only way by which concrete can be mixed. Where bank-run gravel has about the right proportions of sand and coarse material and is to be used, spread that out on the mixing board and put the cement on top. Turn with the shovel several times dry then sprinkle the material thoroughly and continue the turning process until the mass has been shoveled not less than four or five times. Shoveling the mixed materials into wheelbarrows will answer as one turning. A rake should not be used in mixing batches when the coarser material has been added as it draws the larger stone away from the smaller. Some use the rake to mix the cement with the sand.

Sand and cement should never be mixed long before the pebbles and water are added to complete the mixture, because all sand contains sufficient moisture to start a setting of the cement which would rob the concrete of some strength.

It is very necessary in mixing concrete that all of the particles of sand be thoroughly coated with a film of neat cement and water, and that the resulting mortar shall be sufficient to coat thoroughly the larger particles of broken stone so that the whole mass will be firmly bound together. Broken stone, especially some limestones, contain a great deal of fine dust. This prevents a good bond.

Placing the Concrete. Immediately after mixing the concrete should be placed. This suggests where possible to do so, the mixing platform, or the mixer, be located near the point where concrete is to be placed, making it convenient to shovel the concrete directly into forms.

Spading to Secure Density and Good Surface. Concrete batches of ideal consistency are spaded into place rather than tamped. A convenient tool for spading is an old garden spade, or a hoe which has been straightened out so that the blade is in line with the handle. Special spading tools are also made with perforations in the blades which assist to bring the sand-cement mortar against form faces while holding back the coarse particles in the concrete and in this way produce a smooth surface finish when forms have been removed.

Protection of Fresh Construction. Regardless of how carefully the materials for any cement work may have been selected, proportioned, mixed and placed, the resulting success or failure must depend largely on whether or not the concrete is protected against drying out after it is placed. If suitable protection is not afforded, the concrete cannot properly "moist cure" and instead of hardening, simply dries out as a result of evaporation of a large portion of the mixing water. Cement construction which exposes a large surface area to sun and wind, such as walks, feeding floors, barn-yard pavements, etc., must be protected against rapid drying out by a layer of some moisture-retaining material. Sand, sawdust, hay, straw, old canvas, burlap, carpets, or similar covering applied as soon as the concrete surface can be covered without marring it, accomplishes the purpose. Such coverings should be kept wet by frequent sprinkling for a week to ten days.

While the above methods of moist curing are followed for general construction work, very specialized treatment is practiced in concrete product factories in order to secure rapid hardening under accurately regulated conditions of humidity. The most acceptable method of curing is to place the newly made product in a tight steam chamber immediately after molding or casting, gradually raising the temperature until 100° to 125° Fahrenheit has been reached. Moisture is provided by pressure fog nozzles or exhaust low pressure steam to practically saturate the atmosphere without causing condensation on the contents of the chamber. Temperature and humidity are then kept constant for from 48 hours to 72 hours, at the end of which period curing has been accomplished equal to that usually resulting from ten days' to three weeks' storage in moist air at moderate temperatures.

Forms and Reinforcement for Concrete

IN order to use a concrete mixture, forms or molds are necessary so that the mass when hardened will have assumed the required shape and form. For a number of classes of cement construction and products, such, for instance, as sewers, silos, double monolithic building walls, cement block, brick and tile, there are various types of patented forms and machines which permit quite a range of adjustments to adapt them to various dimensions of structures or products for which they are designed. Such forms or molds are almost invariably made of metal, sheet steel being the material principally used.

A large part of cement building construction is, however, done by using wooden forms; and as it is rare for any two structures to be of exactly the same dimensions and detail throughout, more or less special form work has to be done for each particular job. It is possible, however, to design wood forms as unit panels, somewhat like that shown in Fig. 1, having dimensions of 2 by 4 feet or 2 by 6 feet or more, so that the forms may be used repeatedly, at least on certain parts of any square or rectangular structure.

Wood forms are often lined with galvanized iron or sheet steel to make them more durable and to assist in producing a smooth surface on the finished work.

Various kinds of lumber may be used for form construction. When moldings or decorative trim is to be reproduced in concrete, white pine is desirable as it may be worked easily; but white pine is rather expensive, and being soft is not very durable. Hard woods are also expensive and difficult to work. Norway pine and spruce are probably used most for form work.

Contrary to the usual practice in building construction, green lumber or lumber which is only partly air-dried will keep its shape in concrete forms for rectangular construction better than lumber that is kiln-dried. If kiln-dried lumber is used it should be thoroughly wet before concrete is placed. This is because the lumber will absorb the water from the concrete, and if the forms are made tight, as they should be, the swelling from absorption will cause the forms to buckle or warp. Oiling or greasing the inside of forms before use is recommended, especially where forms are to be used repeatedly as it prevents absorption of water and also assists in keeping them in shape when not in use.

It is often possible to build forms from stock lengths of lumber, without cutting and thereby wasting material. After use, forms so built may be carefully taken apart and the lumber can be put to other uses. A form for column footing, for example,

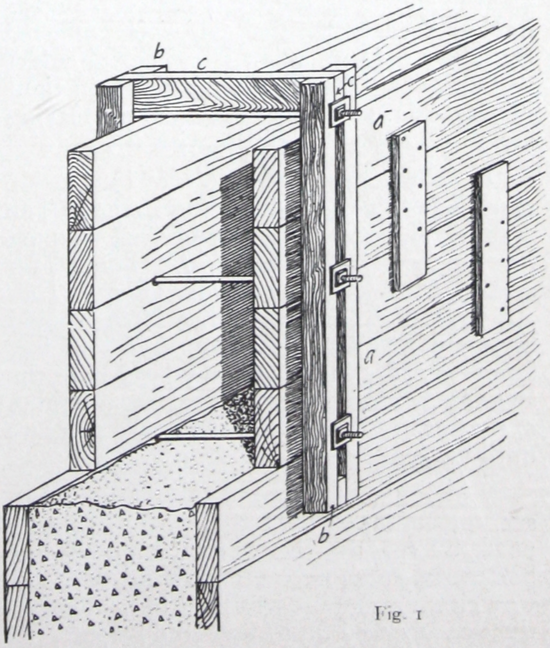


Fig. 1

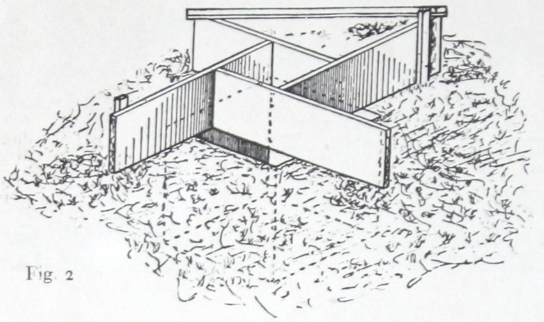


Fig. 2

may sometimes be made as shown in Fig. 2 without cutting lumber.

Form lumber should be free from loose knots or other defects and irregularities that would be reproduced by the concrete. Lumber that is planed on both edges and one side is preferable, as it will give a smooth surface finish to the concrete. It is very essential that lumber for form work, where the concrete is to be exposed, be of uniform thickness, as when nailed to the studs any inequalities of thickness will result in an irregular surface on the concrete. As a rule, 1, 1½ and 2-inch lumber is most used. The added cost of dressed lumber is more than offset by the convenience in handling, working up and placing. Tongued-and-grooved lumber is often used for form sheathing, although what is known as shiplap is better. Lumber having slightly beveled edges is preferred by many because when it swells the edges will mash together enough to result in tight joints; this prevents water from leaking away and carrying cement with it.

Usually 2 by 4's, 2 by 6's, or in extreme cases 2 by 8's are used as form studs. The volume of concrete, or weight that must be supported determines the dimensions and spacing of form studs. Forms constructed with one-inch sheathing, should have studs spaced not more than two feet apart, in order to prevent any bulging of the sheathing when subjected to the ramming of placing concrete, and its outward pressure until hardened.

Forms must be braced thoroughly when set up, and then held the correct distance apart by spacers, these being removed just before the concrete reaches them. Bolts or wire ties may be used to hold forms against the spacers and from spreading apart. If bolts are used they may be greased before concrete is placed so they can be driven out of the concrete easily when forms are removed. It is best to break the bond of the concrete around such bolts within 24 hours. This may be done by merely tapping them with a hammer. Wire ties are generally used and are cut when taking down forms, all of the wire, except the projecting ends, being left in the concrete. Fig. 3 shows how the forms are tightened against spacers by twisting the wire ties.

When a cement foundation is not to enclose a cellar or basement, it will often be found that the soil is sufficiently self-sustaining to permit depositing concrete in the foundation trench without forms, as in Fig. 4. For all work above ground, however, forms are required; these may be of such a type as that illustrated in Figs. 6 and 7.*

As many foundations are provided with a footing, this may sometimes be constructed by omitting to nail sheathing boards on the lower eight or ten inches of the form studs as resting in the foundation trench, thus allowing the first concrete deposited to spread out and form the footing. See Figs. 6 and 7.

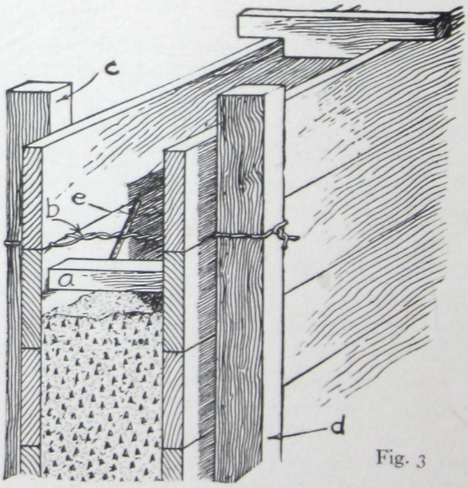


Fig. 3

*When the earth wall is sufficiently self-sustaining to permit dispensing with an outside form, only the single inner form section need be used except when the work has reached a point above ground, then, of course, two forms (inner and outer) will be required. For example, in Figs. 6 and 7 the form next to the earth wall could be omitted if the ground were firm.

ALPHA CEMENT — HOW TO USE IT

As concrete made with ordinary sand, gravel or stone weighs from 130 to 150 pounds per cubic foot, floor and roof forms particularly must be designed with a sufficient factor of safety to prevent them from sagging from their own weight as well as that of the concrete. Any sagging of forms will result in small cracks developing while the concrete is hardening, and these will gradually widen, prevent-

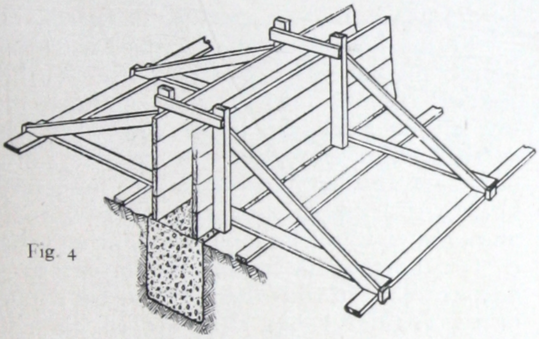


Fig. 4

ing the construction from having the desired strength. Enough braces, struts, and studs must be used to prevent forms from sagging. Various methods of bracing are shown in Fig. 5 and elsewhere.

Forms should be designed with every regard for economy of lumber, and when assembling them as few nails as possible should be used. In some cases screws and clamps used instead of nails will permit removing forms with the least hammering and least injury to the fresh concrete. No very wide boards should be used in form construction, from four to six inches being the preferred widths, with eight inches as the maximum. Wider boards

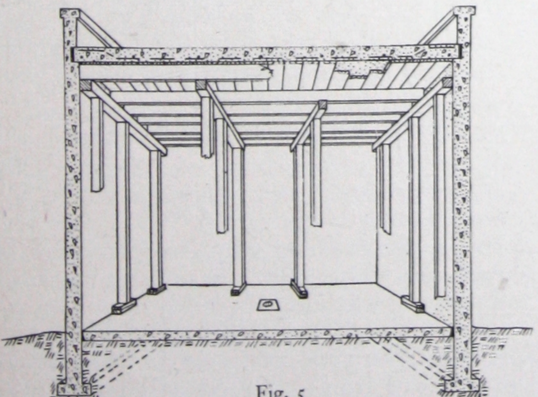


Fig. 5

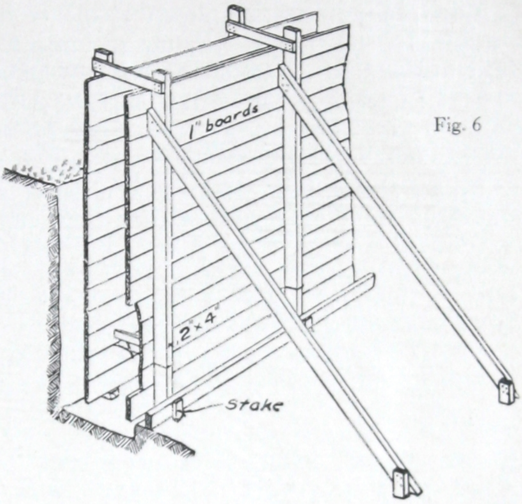


Fig. 6

are difficult to keep from warping and bulging.

Forms for floors laid on the ground and for walks, should consist of two-inch lumber having a width equal to the desired thickness of the floor or walk and should be staked in position. Very few nails if any are needed in forms for walks, feeding floors and similar pavements. Stakes well driven will hold form boards in proper position.

Straight walls and flat floors usually require the simplest types of forms. Corners, offsets, bends and various kinds of breaks or projections from the plain surface, such as in columns, beams, cornices, and walls with openings and angles increase the cost.

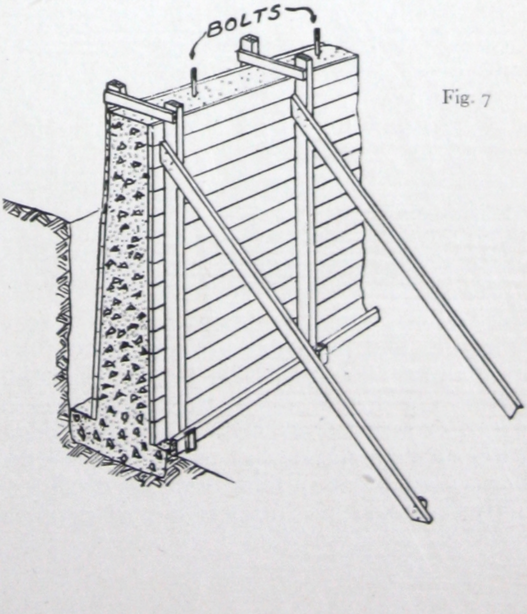


Fig. 7

ALPHA CEMENT — HOW TO USE IT

With care in taking down forms it is possible to use lumber several times, so the longer it is in service the less the percentage of original cost to charge to any one job. For some classes of work form lumber can be used more than ten times.

Unit Forms. The greatest economy is gained by building forms so that they can be repeatedly used. Most people who have paid any attention to a contractor at work building the foundation of a small house, for example, have noticed that he brings to the work a set of standard form panels and sets them up by bracing or otherwise. Such panels represent a convenient form unit permitting most repetition in use. Observe Fig. 9. These units should be carefully handled and each time thoroughly cleaned when taken down preparatory to subsequent use. But few standard panel sections are required. For example, the standard unit may be 2 by 4 feet. Supplemental sections may be 2 by 2 feet, 1 by 2 feet and 1 by 4 feet. A little experience in setting up such forms gained by using them once or twice, will indicate how many of the smaller sized panels may be profitably provided and kept on hand to permit closing up stretches of wall of different lengths. The principal precaution to take in making such panels is to see that the frame studs on which the sheathing is nailed or screwed are cut up and assembled with such precision that the bolt holes for bolts used in assembling sections shall exactly coincide no matter how the form panel may be turned, thus making it possible to set up forms true to line.

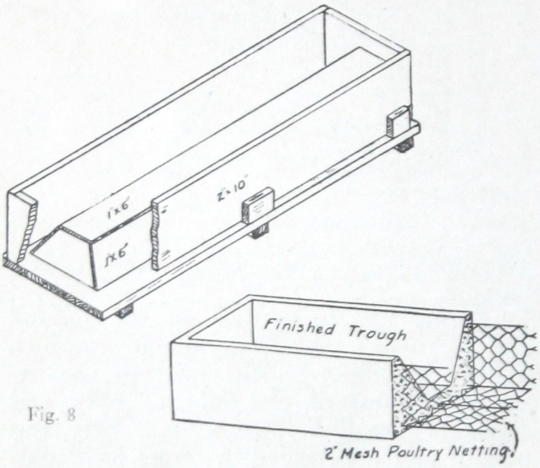
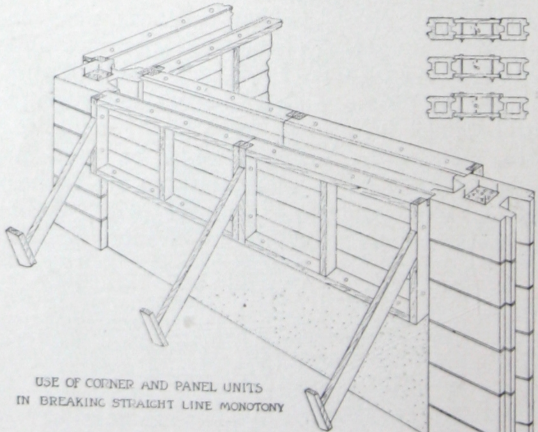


Fig. 8

Miscellaneous Pointers on Forms and Their Use. Concrete will not stick to forms that are oiled each time before use with a mixture of boiled linseed oil and kerosene, equal parts of each, but if not so oiled they should at least be thoroughly wetted down. They should be carefully cleaned of all particles of adhering concrete after removal and be wet down immediately before again placing concrete in them.

Forms for the ordinary types of square or rectangular stock watering troughs, hog feeding troughs (Fig. 8), and manure pits are all of a simple type, and when the earth is firm enough to be self-sustaining only an inside form will be necessary. Otherwise, form construction simply amounts to one frame within another; that is, two bottomless boxes of different sizes, one set inside of the other. Forms for square or rectangular tanks that are to be built above ground should provide for a batter or slope on the inside of the structure so that the expansion from freezing water will be spent upward instead of against the tank sides. Fig. 8 illustrates this. For such tanks as cisterns, which are usually placed wholly underground, of course a form is needed for the cement roof or cover slab. This is in the nature of a floor supported by studs.



USE OF CORNER AND PANEL UNITS IN BREAKING STRAIGHT LINE MONOTONY

Fig. 9

There is no possibility of stating with precision the time when forms may safely be removed from any piece of construction.

This varies entirely with weather conditions and the mass of concrete. Whenever the structure is one which need support no weight but its own, such as a building wall of medium dimensions, all above ground, forms can sometimes be removed in three or four days. There is no advantage, however, in removing forms too early

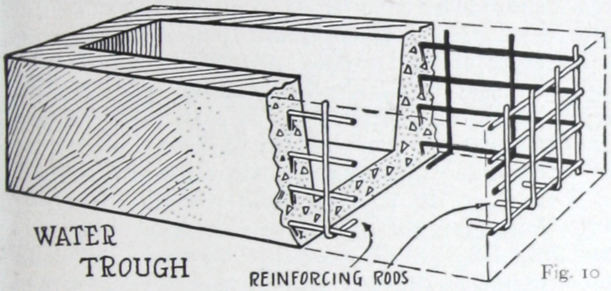


Fig. 10

because the forms afford desirable protection to the concrete in preventing it from drying out during the first few days. Forms for heavy arches, for floors supported above ground and roofs, must all be left in place from ten days to two, three or four weeks. It is a wise plan to leave forms in place a few days longer than may seem absolutely necessary, just to be on the safe side. Such a precaution often marks the difference between failure and success.

Reinforced Cement Construction Materials to Use

"Reinforcing" is the name given to the practice of embedding steel in concrete, to increase its strength against tension, or forces that tend to pull it apart. Concrete, like many building stones, is strong in compression; that is, in bearing loads which are placed directly upon it, but is relatively weak in tension, that is, in resisting forces which tend to pull it apart.

The materials usually employed to reinforce concrete are steel rods of various forms, and woven mesh fabric similar to some of the common types of wire fencing. The reason for this is that specification requirements governing the practice of reinforcing concrete call for steel that possesses certain chemical and other qualities. Perhaps by far the commonest kind of reinforcing used is plain round or square or twisted square bars.

While it is possible to use old barbed wire and other waste materials to reinforce concrete, there are many difficulties and uncertainties attending their use. This is particularly true of barbed wire. The material is very difficult to place and to keep in proper place while depositing concrete, and unless reinforcing is placed and held in correct position while concrete is being deposited, a great deal of its possible effectiveness is lost. Barbed wire and other fencing is purposely manufactured so it will stretch, an essential for fencing purposes which makes it less reliable as a reinforcing material.

If wires are to be substituted for the steel rods recommended, then one should be certain that the quantity of wires used equals in cross-sectional area the amount of rods for which substituted. The same holds true of using mesh fabric in place of rods. Mesh fabric is generally used instead of rods for floor, roof and pavement reinforcing.

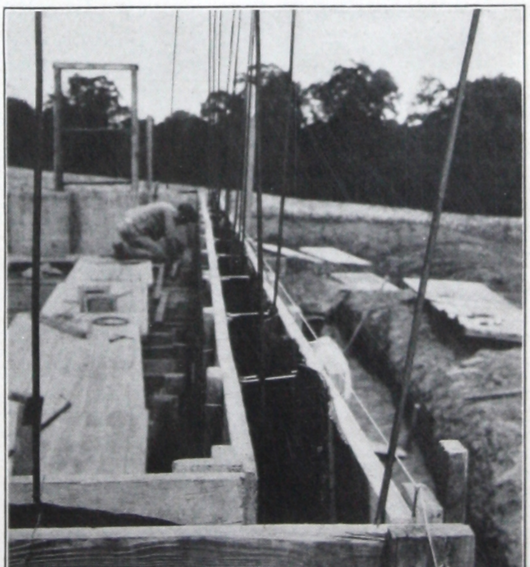


Fig. 11—Reinforcing bars as placed in cement walls

On cement work that has been the subject of engineering design only one general grade of reinforcing steel is considered. This can be obtained from any of the steel companies or through local building materal dealers.

ALPHA CEMENT — HOW TO USE IT

Without going into details as to the physical and chemical properties of steel, it is sufficient to say that steel varies greatly in character; some stretches and bends easily while other kinds are stiff and brittle. This should lead one to realize that not all steel is equally well suited for reinforcing cement work.

Regardless of whether plain round or square, twisted-square or deformed bars are used, the steel should meet what are known as the "Standard Specifications for Steel Reinforcing Bars," of the American Society for Testing Materials. Practically all of the steel companies manufacture reinforcing steel that meets these specifications.

In estimating for reinforcing steel it is best to increase the estimate by 10 per cent over the actual amount calculated for, to cover shortage resulting from cutting.

Reinforcing steel not only strengthens concrete against tension but in many cases makes possible the attainment of a required strength in a structure with considerable economy of concrete. It also serves to prevent cracks that may otherwise result from expansion and contraction under temperature changes. The principal reason for using steel instead of other metals is that the ratio of expansion of steel under temperature changes is so nearly like that of concrete that the two expand in a practically equal degree; therefore, there is no "breaking of bond" between the concrete and steel.

Reinforcing is particularly necessary in tanks or troughs, where freezing is likely to increase pressure. Foundations rarely need reinforcing. Building walls above ground usually do. Note Fig. 11.

The subject of reinforced concrete is a technical one and cannot be touched upon from the standpoint of design. Reinforcing for any structure should not be chosen by guess, although it is possible to specify in an offhand way safe practice for small structures such as the usual barnyard watering tanks or troughs, feeding-troughs, etc. Usually ¼-inch or ⅜-inch rods are used in tanks that are not greater than 2 by 8 feet inside dimensions, and are spaced from 6 to 12 inches center to center, both vertically and horizontally throughout the structure. See Fig. 10.

In reinforcing cement construction the quantity of steel required in a structure may vary from ½ to perhaps 1½ per cent of the cross-sectional area of the concrete. Columns and beams under excessive loads require as much as 4 per cent or more of steel. These figures are of course only general and may vary considerably in individual cases.

Steel used for concrete reinforcement should be free from rust in the form of loose scale that would prevent the concrete from bonding properly with it. To be safe it should be brushed with a wire brush. Sometimes it is necessary to put the metal in a pickling bath, usually made by combining one part sulphuric acid and five or six parts of water, and left there long enough to remove the rust. The rods should be thoroughly washed in clean water to prevent any further action on the steel.

There are a number of patented types of deformed sheet metal marketed under various proprietary names used particularly in floor, roof-slab and partition construction, which in some cases serve as forms as well as reinforcing.

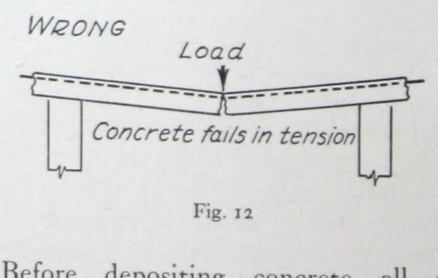


Fig. 12

Before depositing concrete all reinforcing rods should be fixed in proper position so they will not become displaced while placing concrete. This is particularly important for construction that must be fire-safe, since it is necessary that the metal have the benefit of a certain amount of concrete covering, not only to prevent the steel from being exposed but to insure

effective bond. Reinforcing rods in such a structure as a tank, a silo or a cistern, for instance, should be wired together where verticals and horizontals cross.

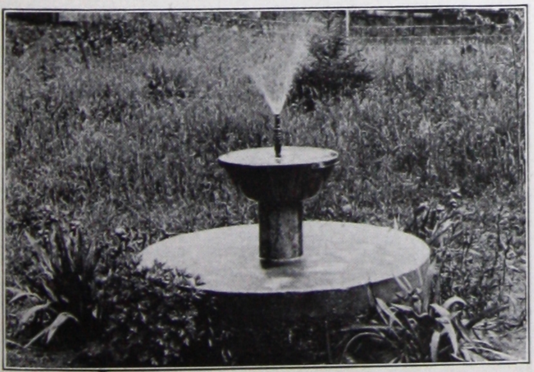
In splicing reinforcing it should be lapped from 50 to 60 times its diameter. This method of joining is more effective as a rule than bending ends and hooking them together, since there is certain to be some slack where rods are so hooked, and if a strain is brought upon the concrete at such a place in the structure then the reinforcing is not effective in resisting tension. A ¼-inch rod should, therefore, be lapped with the rod which it joins not less than 12 and preferably 15 inches. Rods should be bound firmly together with wire wound around the lap. Patented "collar" clamps are also used. All rods used in beams and in floor and roof slabs should have the ends turned to an L-shaped loop or hook to form an anchor in the concrete. There should be at least 1 inch of concrete between the rods and the forms and never less than 2 inches between parallel rods.

When bending rods, bends should be made slowly. Force applied to the cold bar suddenly is quite likely to break it at the point of bending. Examine all bends and angles after made for cracks so as to detect any imperfections before placing the steel in the concrete. Reinforcing rods that are left projecting out of newly deposited concrete for the purpose of splicing other rods to them when work may be resumed should be protected against being struck or jarred, thus breaking the bond between the steel and the concrete. Reinforced concrete failures have resulted from the metal becoming misplaced while placing concrete. It is, therefore, essential that steel be placed exactly as called for in the plans. Note Fig. 12, illustrating correct and incorrect placing of reinforcement.

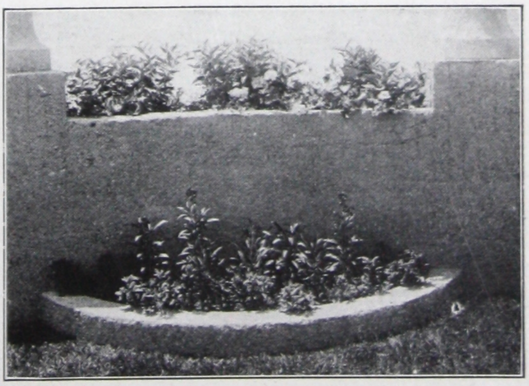
TABLE 7

AREAS OF ROUND AND SQUARE REINFORCING RODS

Diameter or Thickness in Inches	Round Rods Area in Sq. Inches	Weight in Pounds Per Foot	Square Rod Area in Sq. Inches	Weight in Pounds Per Foot
1/16	.0031	.010	.0039	.013
⅛	.0123	.042	.0156	.053
¼	.0491	.167	.0625	.213
⅜	.1105	.376	.1406	.478
½	.1963	.668	.2500	.850
⅝	.3068	1.043	.3906	1.328
¾	.4418	1.502	.5625	1.913
⅞	.6013	2.044	.7656	2.603
1	.7854	2.670	1.0000	3.400



Cement bird bath of simple construction



Use of cement in making flower beds

Concreting in Cold Weather

A GREAT deal of cement work can be undertaken as well in winter as at other seasons. Indeed there is often more time and lower labor cost in winter than during the summer. Posts, drain pipes, rollers, slabs, watering troughs, tanks, floors, etc., can be completed indoors, and—with the exception of floors—the finished work can be put into place outside later. Such work can be done in barns, sheds, basements, etc.

All winter cement work must be done with extreme care. There must be established, through artificial means, the conditions that make for good work during favorable seasons of the year. For very large undertakings considerable equipment is necessary. For small jobs and moderately cold weather the equipment is simple and inexpensive.

There are various methods of protecting cement work in freezing weather. These include the heating of the materials and water to a temperature not higher than 145° F., and protection of the concrete until it is no longer in danger of disintegration through the action of frost.

Heating water and aggregates

Protective methods are usually applied progressively as the weather gets colder. Cement work hardens slowly at temperatures under 40° and in most climates there may be danger of freezing during the night even when the thermometer registers around 40° during the day. Therefore it is considered good practice to commence cold weather treatment at this temperature, not only as a precautionary measure, but also to hasten hardening.

Protecting newly laid walk with building paper and straw

Heating of the aggregates and suitable blanketing of the cement work after placing are the first treatments to be applied, and they are often entirely sufficient even when the temperature is as low as 20° Fahrenheit. The simplest type of heater consists of a section of old metal pipe or culvert inside which a wood fire is built, with the aggregate piled over it. Piles of sand and screened gravel should be kept separate and turned occasionally to make sure that the materials are thoroughly heated all through. Where live steam is available, a large steam coil or grid may be laid down on a floor and the material piled on it, the pile often being covered with a canvas to prevent heat from escaping.

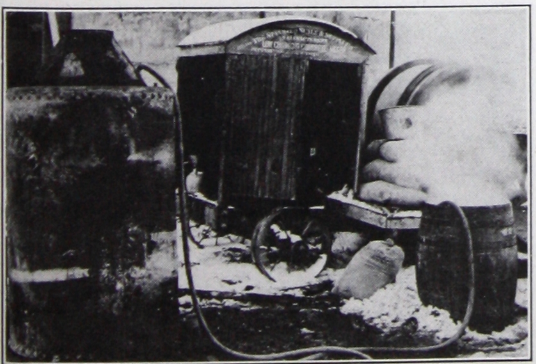
Methods of covering the concrete after placing vary according to the nature of the construction. Foundations are protected

somewhat by the forms, and require only a covering of canvas or heavy paper, often blanketed with straw. Building paper covered with two or three inches of manure makes a very effective covering. This latter method is commonly used for walks and driveways, and as it should be applied immediately to be most effective, the paper should be supported on wooden strips only high enough above the concrete to prevent touching.

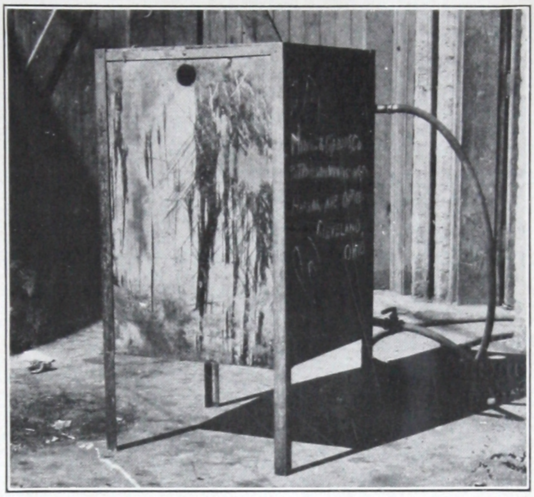
Protection for exposed walls and similar work above grade is more difficult. Canvas covering is placed around the work, being carefully joined together to prevent "frost bites" in small exposed spots. Charcoal or coke stoves are placed within buildings or enclosures where practical, radiators being substituted where steam may be had. Radiators are often placed on the outer surface of the wall, under the canvas. In the building of tanks, bins and other unroofed structures, it is particularly important that a canvas or other covering be placed over the top to prevent the dissipation of heat.

If concreting is to be done at sustained temperatures below freezing, mixing water also should be heated. If there is no steam boiler on the job perhaps the most efficient method of heating water is in large iron kettles over open fires. When steam is available, a steam pipe is usually exhausted in the water barrel. If there is running water but no steam, the water pipe may be connected to a heating coil made of a long pipe and return pipe which may be run through the aggregate heater. Water may be used at practically boiling temperatures.

In extremely cold weather it usually becomes expedient not only to heat the aggregates and the water, but also to introduce heat into the mixer drum in order to prevent loss of heat there. The openings in the drum are fitted with canvas flaps and a steam pipe exhausted within, or the drum heated by a patented heater constructed on the principle of a blow torch, using kerosene fuel. It is always wise to locate the equipment where protected from cold winds and storms as far as possible and also as convenient as may be to the points at which the concrete will be deposited.



An old steam boiler used to heat mixing water



A combined salamander and water heater

Little benefit is derived from heating of the cement and under no circumstances should any reliance be placed on the heat generated by the cement in hardening, as some have wrongly advocated. A small amount of heat is given off in the reaction between the cement and the water, but it is too small to be of any assistance in the protection of concrete against freezing.

Common salt has been advocated and occasionally used in the mixing water to lower the freezing point. This practice is not recommended because sufficient salt to lower the freezing point more than four or five degrees cannot be used without fear of reducing the strength of the concrete, at the same time greatly increasing the possibilities of efflorescence, a chalky white deposit sometimes seen on masonry surfaces. At best salt only lowers the freezing point of water and does nothing to increase the very slow rate of hardening at these temperatures.

Calcium chloride is used with better success, but its use should be carefully prescribed for each particular case. Four pounds of calcium chloride to the sack of cement is the limit recommended under any circumstances, as greater quantities affect strength adversely and may cause efflorescence.

In order to do cement work in winter it is usually necessary to procure the sand and gravel or stone in advance, before the pits or other sources of supply become frozen up. Materials stored for winter use in concrete should be protected against moisture and in cement products plants are sometimes placed in large steam heated bins to facilitate handling and make sure all frost has been removed before using. Where necessary to store aggregates out in the open, heaters or steam pipes are often placed under or in the pile so that these may be utilized to thaw and heat the material when needed.

Fireproofing

No other structural material has given such a good account of itself when exposed to severe fire tests as concrete. It will not burn and is a slow conductor of heat.

Scarcity of timber in large sizes has resulted in a rapid advance in price of such material within late years and this has brought about a situation whereby absolutely fire-safe cement buildings can be built for the same cost or at least little greater cost than required for buildings that are thoroughly combustible.

Protection of Reinforcement. In all fireproof construction it is very necessary that reinforcing be held in proper position while concrete is placed so the steel will have a sufficient protective covering to prevent heat from warping or melting it. As a general rule reinforcing steel in floor slabs should be protected by not less than a 1-inch covering of concrete, in beams by not less than 1½ inches, and in columns by not less than 2 inches.

Chimney Work. Concrete is used largely and very successfully in chimney construction, from the requirements of the smallest cottage to those of the great smelters in the west employing stacks two or three hundred feet high. Unlined concrete chimneys have been successfully used where the temperature of the gases entering the chimney is 1000 degrees Fahrenheit or over. Even under continued exposure to the high temperatures of unusually hot fires, the surface of the concrete to a depth not exceeding a fraction of an inch may be partially calcined or reduced to a substance resembling unslaked lime. This thin layer of calcined concrete on the exposed surface transmits heat very slowly and therefore forms an efficient protection for the remainder of the mass, which is not heated to a sufficient degree to cause the slightest injury.

Concrete chimneys which are cast in place should not be exposed to any considerable heat, such as that from a large furnace or boiler, until 30 days old. This limitation should be observed in order to insure time for the concrete to cure thoroughly before it is exposed to the drying action which might evaporate off the water of crystallization.

Since it is necessary to reinforce concrete chimneys cast in place, using designs prepared by competent engineers, it is usually easier to build chimneys for residences, garages and moderate sized commercial buildings of precast cement units, such as ordinary building blocks or special chimney blocks. See page 38. These are carefully laid in 1:3 cement and sand mortar with inside joints pointed flush and trowelled smooth. Never lay chimney construction in lime mortar. If first class cement blocks are used and carefully laid, it will be unnecessary to use flue lining for the chimneys of ordinary dwellings where temperatures are moderate as compared with those which come from commercially operated boilers. Flue lining costs very little, however, and may be considered as safe and sane insurance by those who may doubt the efficiency of unlined flues.

In the past, masonry chimneys for small residences occasionally have been supported on timber wall brackets. Experience has shown this practice to be exceedingly dangerous and it should never be followed. Chimneys should rest on ample supports of cement construction. For the bearing capacity of various soils see paragraphs under "Foundations for Small Buildings," page 69. Footings for chimneys should go down to firm ground well compacted, and if exposed they must go below the line of maximum frost penetration.

Making Concrete Watertight

Joining Each Day's Work. Leaks in tanks, troughs, cisterns and similar structures sometimes result from the fact that no precautions were taken to join correctly the concreting of different days' work. When concreting is stopped the surface in the forms should be left rough so that there will be an opportunity for the concrete placed the following day to bond to the old concrete. The surface should be well washed, and painted with a cement grout paint mixed to the consistency of cream, applied immediately before placing new concrete. Some contractors when discontinuing work on tanks, silos and troughs, embed a 6 or 8-inch strip of tin or thin stovepipe iron into the concrete, leaving half of it to project in the concrete to be deposited the next day, also painting the surface with a cement grout paint immediately preceding the placing of fresh concrete.

Density by Proper Grading of Aggregates. Concrete may be made so dense that it will resist the passage of water even under very high pressure, or so porous as to constitute a good filter. Watertightness depends primarily upon gradation of the particles, plasticity or "workability" of the mass and upon the proportion of cement used.

The fact that porous concrete has been made occasionally where watertight concrete was desired has led to the marketing of various compounds intended to increase the watertightness of concrete. While many, if not all of these compounds accomplish temporarily at least the purpose intended, none of them are essential to securing watertight construction. Some of these preparations are of questionable composition, and few if any of them have been in use long enough to prove that the results obtained by their use are permanent. The use of these "guaranteed" compounds is dangerous in that it is likely to encourage careless proportioning and mixing as unnecessary when the "preparation" is to be added.

If reasonably well graded materials are used, a 1:2:4 or 1:2½:4 mixture will keep out water unless the latter is under pressure. If a "head" or pressure of water is to be resisted, a 1:2:3 mixture is recommended, or a 1:2½ mixture of cement and sand may be used if screened gravel or stone are unavailable, or conditions such that the use of these coarser particles is impracticable.

Proportioning concrete for water-tightness, hence for maximum density, depends upon obtaining in the mixture enough sand to fill the open spaces between the particles of large aggregate, and sufficient cement to fill the open spaces which remain in the combined sand and pebbles or stone.

Hydrated lime, sometimes added to concrete mixtures, acts only as a void filler. The danger in it is that too much lime may be used, affecting the strength of the concrete and sometimes causing efflorescence, a white, chalky, deposit on the surface. A little additional cement, without the lime, would serve the same purpose without the dangers.

Amount of Water. In order to get the most favorable plasticity or condition of workability, in which the particles can be thoroughly mixed and manipulated without any separation of the coarse from the fine, only sufficient water should be used to give normal consistency (as explained on page 13) in which condition the concrete will slump slightly in a pile, will be quite mobile and easily handled in forms or molds, moisture appearing on the surface under light tamping.

If dryer mixtures are used they must be compacted by heavy tamping or the application of direct pressure, which produce results comparable with light tamping of more plastic mixtures.

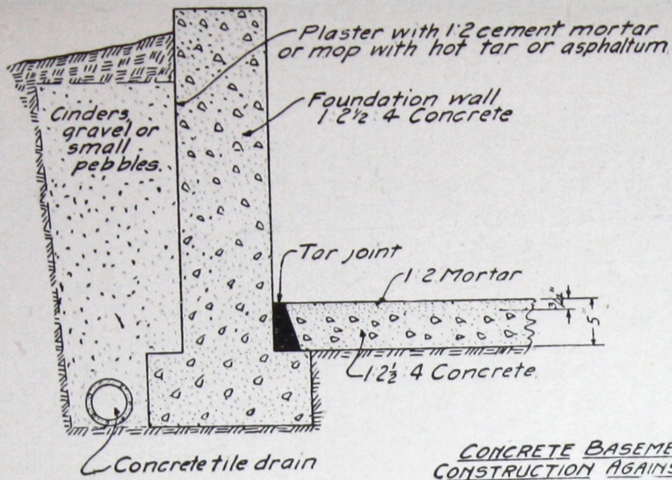
A graceful design

Building a Watertight Tank or Cistern

1. Secure a good design, study and follow it closely.
2. If the tank will be built below ground (as cistern, septic or water supply tank) excavation must be carried below frost penetration. There should be no water in the excavation when concrete is placed. If ground water flows into the excavation it must be diverted to a deep hole or sump from which it can be pumped or bailed out, in order to prevent water pressure on newly placed concrete.
3. Use forms and a method of building which will permit placing all of the concrete at one time.
4. Be sure to use the mixture recommended for the purpose in the table on page 12.
5. Use just sufficient water to produce a quaking mix, so that moisture will flush to the surface under spading and light tamping.
6. First place concrete for half of the floor thickness, then place the reinforcing in position accurately; then complete concreting before the material previously placed has had a chance to harden.
7. Remove the forms carefully as soon as practicable. In moderate weather they usually may be removed at the end of two days, pockets and holes filled with mortar and the surfaces scrubbed or painted with a creamy 1:3 mixture of cement and water.
8. Cure carefully, keeping all surfaces moist for at least one week.

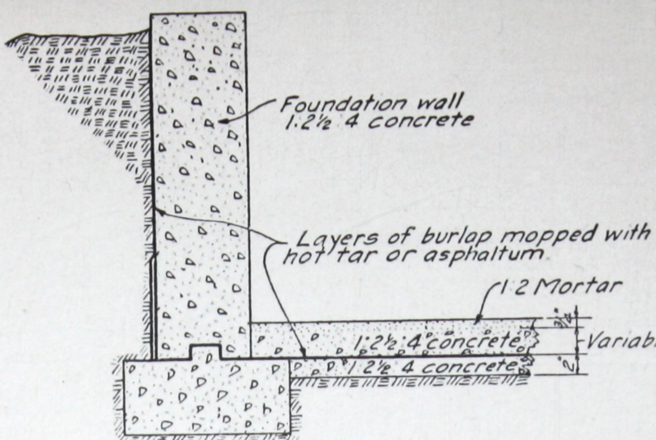
To Make a Basement Watertight, Using Monolithic Concrete Placed in Forms

1. It is desirable that the work be undertaken in dry season as water pressure on newly completed walls is more likely to be avoided.
2. Place forms securely after making sure that footings will rest on firm, well-compacted soil below frost penetration.
3. If possible place concrete from footings to grade level at one continuous operation using just enough water so that moisture will flush to the surface under light tamping and spading. If necessary to discontinue operations with basement wall partly completed fill the forms all around to the same level, leaving the surface of the concrete rough and covered to protect it against drying out or becoming dirty. Scrub the upper surface of the wall with a cement and water wash just before resuming the placing of concrete upon it.
4. Remove the forms as soon as practicable, and while the surface is still damp, fill up all holes or blemishes with mortar—1 part cement to 2½ parts sand—made from the same material as used in the wall. Then scrub the surface inside and outside with a cement and water wash, of the consistency of thick cream.
5. Sprinkle the surfaces to prevent them from drying out for at least one week.
6. Place the basement floor as indicated in the sketch.
7. Place drain tile around wall as shown and run it to a suitable outlet, unless soil is high and well drained. Place 8 inch to a foot of crushed stone or gravel over and around the tile.
8. In addition to the cement and water wash, surfaces are sometimes mopped with hot tar or a suitable asphaltic preparation, as well. For this treatment the surface of the walls must be absolutely dry, for these substances adhere only imperfectly to damp surfaces. The material should be applied as hot as possible, special care being taken that every minute area in the entire surface is entirely covered.
9. In filling up excavation place backfill to a depth of about 12 inches and then tamp it until compact, adding water if required. Continue placing backfill in this manner until grade is reached, sloping the surface of the fill away from the house. After two weeks interval, tamp the surface again, to fill any pockets remaining after previous tamping.



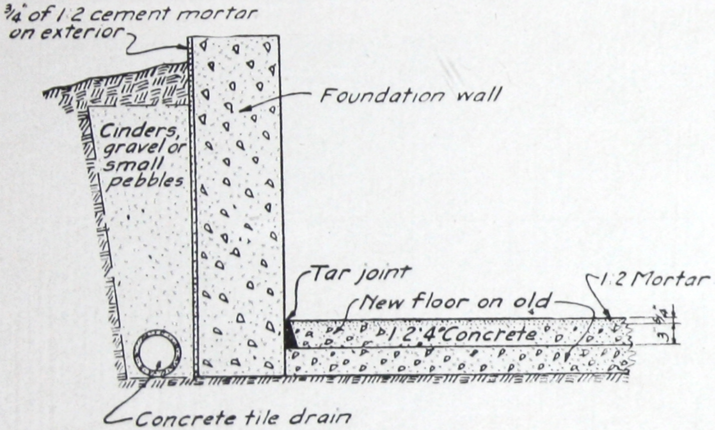
CROSS SECTION

CONCRETE BASEMENT CONSTRUCTION AGAINST SEEPAGE



CROSS SECTION

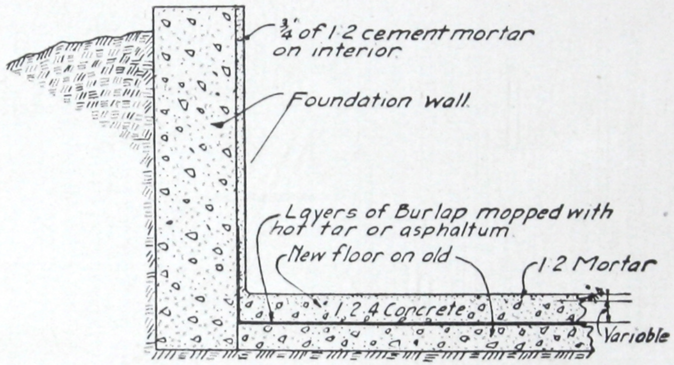
CONCRETE BASEMENT CONSTRUCTION AGAINST GROUND WATER PRESSURE IN LOW GROUND



CROSS SECTION

REPAIRING OLD BASEMENT TO STOP SEEPAGE.

Note: Cut out and fill cracks in floor and wall before placing new floor or plaster coat



CROSS SECTION

Note: Construction suggested where outside of wall cannot be reached nor drainage of foundation provided. Thickness of new floor depends on height of ground water above basement floor in wet weather.

REPAIRING BASEMENT TO PREVENT ENTRANCE OF GROUND WATER

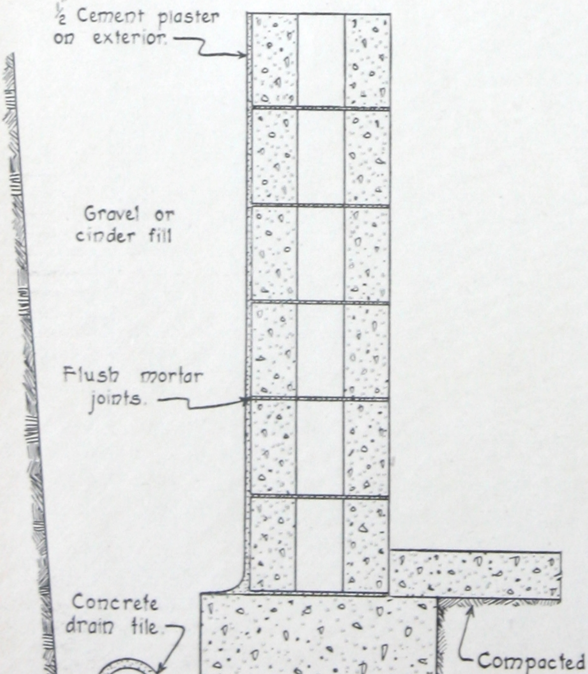
Methods of constructing and repairing monolithic foundation walls to make them watertight

ALPHA CEMENT — HOW TO USE IT

To Make a Watertight Basement Using Cement Block or Cement Tile Foundation Walls

1. With footing still damp, place first course of block in bed of 1:3 cement and sand mortar sufficiently deep to properly seat each block and level the course. Lay succeeding courses using plenty of mortar to provide maximum bedding area and buttering both ends of every block. Fill and strike all joints flush outside and inside.
2. Apply a coat of 1:2½ or 1:3 cement and sand mortar, washing over the surface with a calcimine brush while still soft.

   Laying of the floor and drain tile and placing of the backfill are done in the same manner as for monolithic cement foundations. Inside of wall below grade may be plastered with cement mortar in the same manner as the exterior surface, if desired. In cases where it is impossible to plaster the exterior of the wall, similar coat on the interior may be used.



Recommended method of building a watertight basement wall with cement block

Waterproof Repair Methods

It is usually much easier to make concrete watertight by the use of good practice in the process of manufacture than it is to employ methods later to stop the passage of moisture already begun. However, a number of successful waterproofing repair methods are available, the choice between them being dependent upon the nature of each particular job.

Sodium silicate (ordinary water glass) or preparations containing it, are frequently found useful in sealing porous concrete as a means of stopping seepage. A solution made up of 1 part sodium silicate to 3 to 5 parts water, applied to the dry surface of the porous concrete will eventually fill the pores and render the surface watertight, if put on in two or more coats at intervals of 24 hours. Three coats are usually sufficient to seal almost any surface, although four applications will give better results on very porous surfaces.

Similar treatment is sometimes given substituting paraffin for sodium silicate. By this method the surface is thoroughly dried and warmed with a blow torch, the paraffin being applied with a brush as a thick liquid. It is then melted and driven into the pores by the heat and pressure of the flame. Pitch and other asphaltic materials are frequently applied to the wall with a swab or brush, giving good results in mild cases. For this treatment it is extremely important that the concrete be absolutely dry and the pitch as hot as possible.

These treatments are applied successfully on the inside of small tanks and cisterns, cellar walls and similar places where the leakage is relatively small and due to seeping through pores in the concrete rather than to open cracks or large breaks. For these reasons they are sometimes referred to as "dampproofings." Major waterproofing repairs are always made with rich Portland cement mortar or concrete used as the filler or coating. Wherever possible it is applied to the side of the wall or tank from which the water enters, but where this is not practicable it may be applied to the surface on which the water appears. Whereas sodium silicate, paraffin, pitch and other asphaltic paints must be applied to dry surfaces, cement mortars and washes are applied more successfully to moist surfaces.

ALPHA CEMENT — HOW TO USE IT

A foundation wall of cement block properly plastered with cement mortar below grade

Methods of Repairing Leaks in Tanks and Cisterns Placed Below Ground

1. Serious general leaks through walls that are obviously porous, are usually best repaired by exposing the exterior wall surfaces and covering them with a ½-inch coat of cement mortar made of 1 part cement to 2½ parts fine to medium coarse sand. (Minor leaks, in the nature of light seepage, may be repaired by the use of sodium silicate solution, described in a preceding paragraph.)

If the surfaces to be plastered were originally given a smooth trowelled finish, the latter should be roughened with a bush hammer or similar tool, then moistened and painted with a thick cement and water wash before applying the new plaster coat.

2. Leaks through a structural crack in the wall can be stopped by chiseling out the crack, forming a V-shaped channel at least 1 inch deep, painting it with cement and water wash as described in the preceding paragraph, then filling the channel with cement mortar, firmly pressed and trowelled into place.

3. Water entering the tank through the floor indicates that there is considerable pressure behind it and suggests the need of a tile line running around the tank and to a suitable outlet. If it is impractical to relieve the pressure in this manner, a deep hole or sump should be arranged to take the pressure off the tank floor until repairs can be made.

The surface should be cleaned thoroughly, then scrubbing it with a cement and water wash, following this treatment immediately by placing over it a 2-inch mortar coat, made of a 1:2½ mixture of cement and building sand. More serious cases are treated by cleaning off the floor surface as suggested above, covering it, while absolutely dry, with a coat of hot pitch or other asphaltic preparation recommended for the purpose. A layer of burlap may be laid on the pitch and another coat of pitch applied. A 2-inch coat of cement mortar, as described above, may then be placed over the pitch. This treatment is preferably extended up on the walls for a distance of 12 to 18 inches. Water pressure must be entirely relieved for a period of at least one week, and preferably ten days to two weeks.

Where foundations are exposed to constant pressure of ground water, a coat of asphaltic paint is sometimes applied over the cement mortar

ALPHA CEMENT — HOW TO USE IT

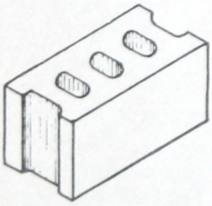
Cement Block and Cement Building Tile

While many structures have been built of rock faced block and may be seen in use today, this type of cement block has fallen into disuse except for grade courses and occasionally the walls of farm buildings. This is due to the fact that the rock face pattern is not only inappropriate for other uses but it is usually unattractive and sometimes even ugly.

Of recent years the artistic possibilities of cement work have been given more thought and attention, with the result that cement block have been developed with surfaces of selected aggregates which equal and occasionally exceed in beauty and durability most natural building stone. These surfaces are produced with selected mixtures of portland cement and marble, granite, mica spar—in a variety of sizes and colors. No attempt is made to follow the irregular surface

Types of Cement Block in Common Use with the Trade Name of Each

1. Anchor, Besser, Hobbs, Post, Standard and Universal.
2. Colonial, Eclipse, Foote, Francis, Hercules, Ideal, Improved, Kramer, Monarch, Multiplex, Papke, Perfect, Pettijohn, Wizard, X-L-A-LL and Hotchkiss.
3. Zagelmeyer.
4. Atrax.
5. Anchor and Bragstad.
6. Hydrostone.
7. Helm.
8. Synstone.
9. Flexo, MacArthur and Climax.
10. P-I-C-A-B-B-S.
11. Acme.



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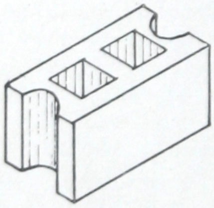

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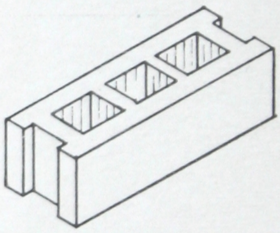

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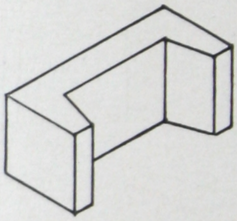

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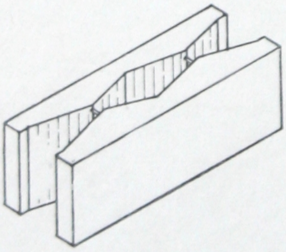

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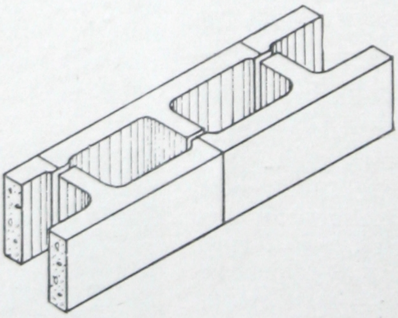

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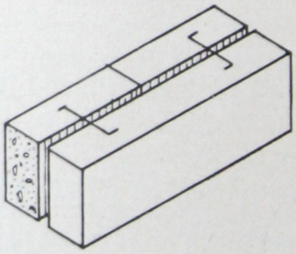

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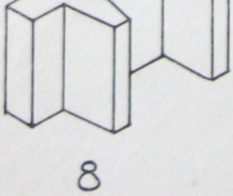

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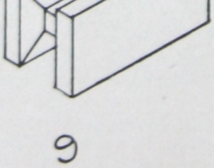

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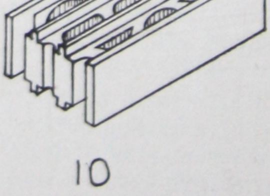

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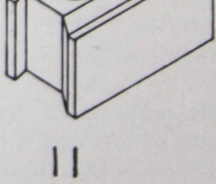

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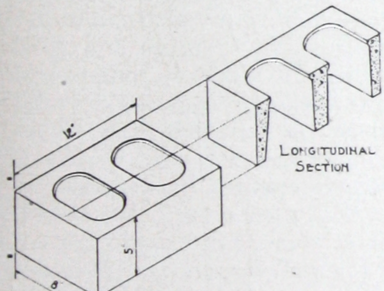
lines of hewn stone; modern cement block have flat faces—all true to plane, with definite sharp, straight corners.

The preponderance of cement block output today is in flat faced units of moderately rough texture, used for foundations and also in the upper walls of buildings up to perhaps four stories in height. The uniformly rough, flat texture forms a perfect surface for the application of cement plaster below grade and artistic cement stucco for the upper walls. As the block furnished for a given piece of work are usually all made from the same material using the same mixture, walls laid up with them will be found remarkably uniform in absorption and texture. Uniform absorption guarantees uniform suction for the stucco; uniformly rough texture provides the best kind of mechanical bond and ease of laying in a true plane makes it possible to obtain a first class stucco job with minimum amount of material and labor.

Cement blocks usually contain air spaces equal to one-third to one-half of their gross volume, which lightens construction (still retaining amply sufficient strength) and provides better insulation against passage of heat and cold. Cement building tile have air spaces occupying from one-half to three-quarters of their gross volume, giving a lighter weight unit for relatively low bearing walls as well as partitions and other non-

Types of Cement Building Tile in Common Use with Trade Name of Each

1. Besser.
2. Blystone.
3. Duntile.
4. Eberling.
5. Hytest.
6. Ideal.
7. McIntyre.
8. Stone-Tile.



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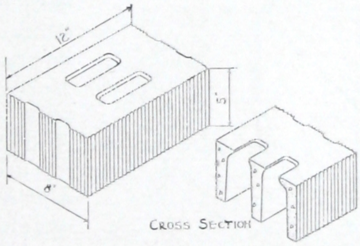

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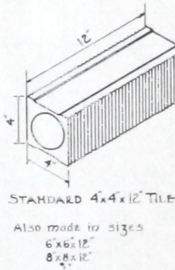

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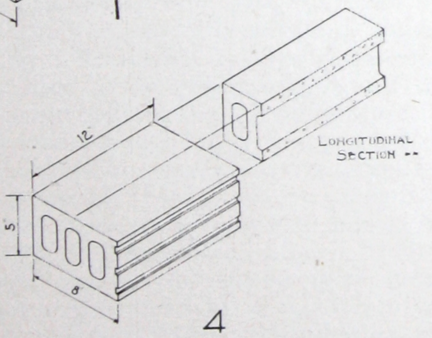

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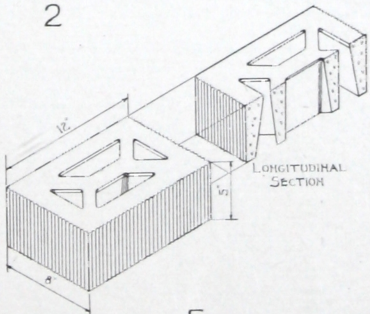

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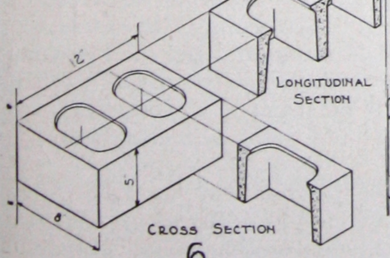

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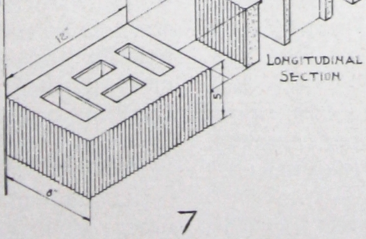

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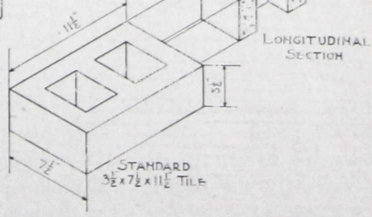

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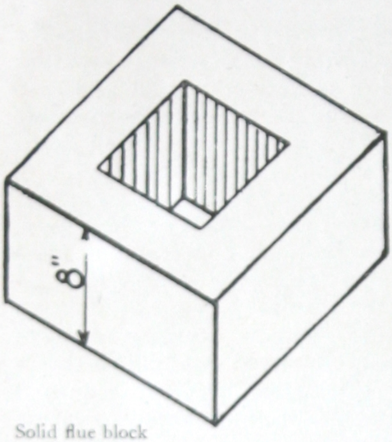
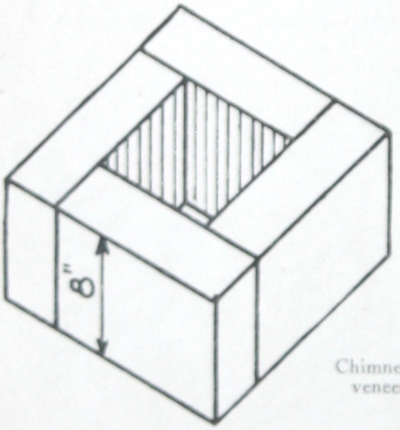
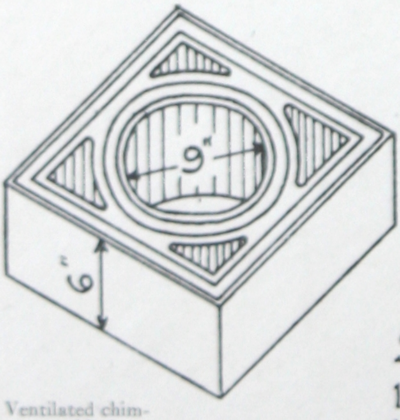
ALPHA CEMENT — HOW TO USE IT



Solid flue block



Chimney construction of veneer or joist block



Ventilated chimney block

bearing construction, "back-up" for face brick masonry and similar uses. The tile is usually made of relatively stronger concrete, so that it will support the same load per unit of gross area as does the block.

The prevailing size of block has a face 16 inches long and 8 inches high (less $\frac{1}{4}$-inch to $\frac{3}{8}$-inch each way for mortar joint) and is made in thicknesses of 8, 10 and 12 inches to provide the wall thicknesses usually required by building regulations. The most popular size of building tile has a height of full 5 inches, width of full 8 inches and length full 12 inches occupying $\frac{1}{2}$ square foot of wall surface are usually laid. Both of these sizes will be found convenient where desired to use in connection with brick masonry. A number of other sizes are in more or less general use.

Block for Special Purposes

In addition to the cement blocks and building tile referred to in preceding paragraphs a variety of similar units—both hollow and solid—are available for many special uses. Silos, water and grain tanks and coal pockets are frequently made of hollow block 8 inches thick, made to fit into circumferences of sizes desired. Cisterns and catch basins are commonly made of tongue-and-grooved or interlocking block, made solid, with a thickness of 4 inches to 6 inches. Millions of these block are used each year for use for manholes, catch basins and conduit outlets in the larger cities. These block, or large diameter cement drain tile are frequently used for well linings and probably provide the best and most economical method in almost all cases.

Several types of cement chimney block are being successfully used both in the cities and in rural districts. See types shown on this page. For small and moderate size dwellings, private garages and small miscellaneous structures well made chimney block, laid in a mortar made of 1 part cement to 3 parts sand, with flush joints and a thin plastered coat of cement mortar on the inside, will be found at least equally as safe as unlined brick chimneys with walls 8 inches thick. The use of flue lining is commonly recommended or required by the building departments for chimneys of all masonry materials. Flue lining adds little to the cost of the chimney and provides safety against fire even if the construction of the chimney should be slighted in some way or the flue be subjected to most intense heat.

Manufacturing Methods

Cement block and building tile as well as most other cement products, are usually

manufactured better by machine than by hand. Block making machinery providing iron or steel mold boxes into which the concrete is compacted by hand are inferior to the larger and heavier molding machines above which are mechanically driven tampers. Power tampers operate uniformly all day long—producing products at 5 o'clock in the afternoon which are just as well compacted as those made at 8 o'clock in the morning. This is not always the result where the tamping is in the hands of the workmen. Heavy rigid machinery reduces the vibration to which the product is subjected in manufacture, thereby eliminating any chance of cracking from this cause.

In addition to the "tamping" type of equipment for making cement building products there is also the "pressure" process, the concrete being compacted by means of direct and increasing pressure; the products being "squeezed" instead of "tamped." Cement block and building tile are also made quite frequently by the wet casting process, in which rather wet concrete is run into "gang" molds preferably arranged on a car standing on a vibrating platform located directly before the mixer. The wetness of the mix, as well as the vibration serves to compact the mass. If the amount of water used is held to the minimum necessary for good edges, products of excellent quality are made.

Mixtures suggested for the manufacture of cement block and building tile, contained in the table on page 12, are given only as approximate. Where more scientific methods are not available, follow this procedure: Accept, for example, a 1:2½:4 mixture, the 2½ parts being well graded sand (up to ¼ inch) and the 4 parts being pebbles ranging in size from ¼ inch to ¾ inch.

1. If this mixture gives very smooth surfaces it may be assumed that less sand can be employed. Then either reduce proportion of sand (if compression tests in a good laboratory show the block not overly strong) or increase the proportion of the larger material, if block have been giving somewhat greater strength than required. Continue to reduce sand or add pebbles or stone as long as acceptably smooth surfaces and sharp corners are obtained.

2. Use as much water as possible within operating limits of tamping or pressure type machines; use as little water as possible if employing a wet molding system.

Laying foundation and walls of cement tile. No forms required. Insulation is thus ideally provided for

3. Coarser grading always increases strength as long as there is satisfactory workability. Finer material in the mix makes surfaces smoother and corners sharper.

4. The use of more cement in the mixture always increases strength.

5. If block are to be used as a base for stucco or a cement plaster coat, a uniformly coarse texture, created by using a coarse grading of material is desirable, although even quite smooth untrowelled surfaces of block afford plenty of bond for coatings.

Most cement block are manufactured today in commercial cement products plants many of which have a large annual output—some of them a million block or more. Factory-made block and tile are superior to home made units because of greater uniformity and other qualities acquired through the use of large equipment, uniform operation and adequate curing. Curing is discussed in considerable detail on page 20.

Cinder Cement Blocks

In many localities building block made of cinder concrete are being offered for foundation, bearing wall and partition purposes. While these block are made to meet strength requirements of the standard product, they are approximately 30 per cent lighter and may be nailed into. The latter feature is an obvious convenience in attaching door and window frames, scaffolding and interior fittings. The manufacture of cinder cement blocks, which is involved in certain patents, should be undertaken only by regularly equipped cement products factories provided with properly prepared cinders of dependable quality.

Laying Cement Block and Cement Building Tile

Mortar. Portland cement mortar, made with one part cement to 3 parts plaster sand and not more than 10 pounds of hydrated lime per sack of cement, is recommended for laying concrete and other masonry. Long experience and innumerable tests prove that Portland cement mortar has greater bonding power, compressive strength, density and resistance to weather. Where maximum strength is not needed mortar may be made of 1 part cement to 1 part hydrated lime and 6 parts building sand, but little is gained since the latter mixture costs approximately as much as the former. Mortar should be thoroughly mixed with just enough water to give it a "pasty" or "tacky" consistency.

Putting cement-block foundation under old barn. In this way many farm buildings can be given a longer lease of life

Mortars may be colored where desired, following the directions given on page 50. In laying block and building tile plenty of mortar should be used and spread so as to produce a perfect bed. Both ends of every block or tile should be buttered in order to produce tight vertical joints.

Wall details. In building with cement block or tile, construction may be simplified by holding as far as possible to horizontal dimensions which will require only whole and half length units. This practice avoids cutting block or fitting in fractional sizes. In the same way, window and door frames should exactly fit an even number of course heights. Thus, if the courses are of blocks which lay with a height of 8 inches in the wall, openings 6 feet, 5 feet 4 inches, or 4 feet 8 inches in height, with 5 or 6 inch sill, fit exactly. Commercial manufacturers of cement products supply "jamb" block to fit all ordinary designs, which aid greatly in securing weathertight connections around all openings.

Lintels and Sills. Lintels are usually pre-cast, that is, molded previously. Simple wooden molds are usually employed for this purpose, the sides being bolted or clamped together so that they may be easily taken apart in order to remove the lintel (usually in 24 hours) without fear of damage. It is convenient to make lintels the same height as the block courses, and their length should be such that each lintel will exactly displace whole and half wall blocks. Where the openings are wider than 3 feet, the lintels must be reinforced. The steel rods used for this purpose are placed one inch above the bottom of the lintel. Two half-inch rods, symmetrically spaced, are used for lintels with clear span from 3 feet to 4 feet, three rods of the same size are placed similarly in lintels having a span of 4 feet to 5 feet. Lintels must always be so marked on leaving the mold that there will be no difficulty in distinguishing top and bottom. Should a lintel be placed in masonry upside down, the rods would not serve to any purpose, or should it be placed on its side, only one rod would be placed to take care of the load.

Window sills are usually of the "slip" type, which are cast in advance but set in the openings, and not so placed that they carry any of the weight of the masonry above.

Cost of Laying Cement Block

A recent number of the magazine "Concrete" in a table showing the cost of laying cement block as compared with ordinary brick, says that these figures "present sufficient evidence to indicate unquestionably the money-saving opportunities in laying cement block." The greater number of reports would indicate, however, that 800 to 1500 brick are being laid today in common practice.

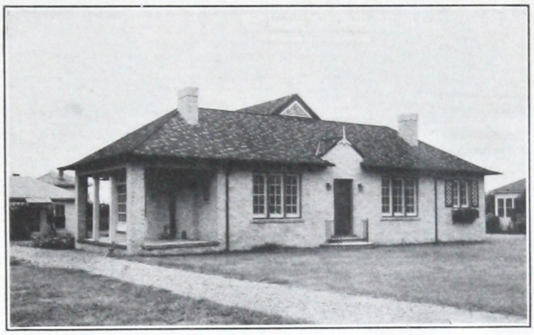
"The table also shows that from 75 to 400 standard 8 x 8 x 16 block are being laid in first floor work, but about 62% of the reports used in the table show that from 200 to 300 block are laid per day in the territory represented.

"One fact seems clearly proven by the table and accompanying diagram: Block are cheaper to lay than are brick. From a great majority of the reports, block are much cheaper to lay. Savings of from 20 to 50% are commonly reported. These figures mean no small amount when translated into terms of our annual construction bill for the country."

ALPHA CEMENT — HOW TO USE IT

Cement Brick. Cement brick is rapidly becoming popular in many of the largest eastern cities such as New York, Philadelphia, Baltimore and Atlanta, as well as hundreds of smaller cities throughout the country where they are now manufactured. As a result of an exhaustive series of tests at Columbia University, proving the remarkable mortar-bonding ability as well as strength of cement brick, the building department of the city of New York has admitted this product and fire underwriters of that city have accorded it insurance rates comparable with superior quality clay brick.

Cement brick are made in practically the same way as cement block. In size they conform to the established dimensions for clay brick for convenience in interchanging or joining walls of the two kinds where necessary. A 1:5 mixture of cement and aggregate is commonly used, in which the 5 parts represents about 60 per cent sand and 40 per cent pebbles or stone ranging in size from ¼-inch to ½-inch or more. In some systems of manufacture a small amount of aggregate up to 1 inch in size can be used. This practice makes for economy of manufacture and for strength, but may add to difficulty of cutting the brick, which in some cases is an important consideration. It is a good rule in brick manufacture to use as much coarse material (all above ¼-inch) as can be carried in the mixture without causing excessive roughness of texture and breaking of the corners.



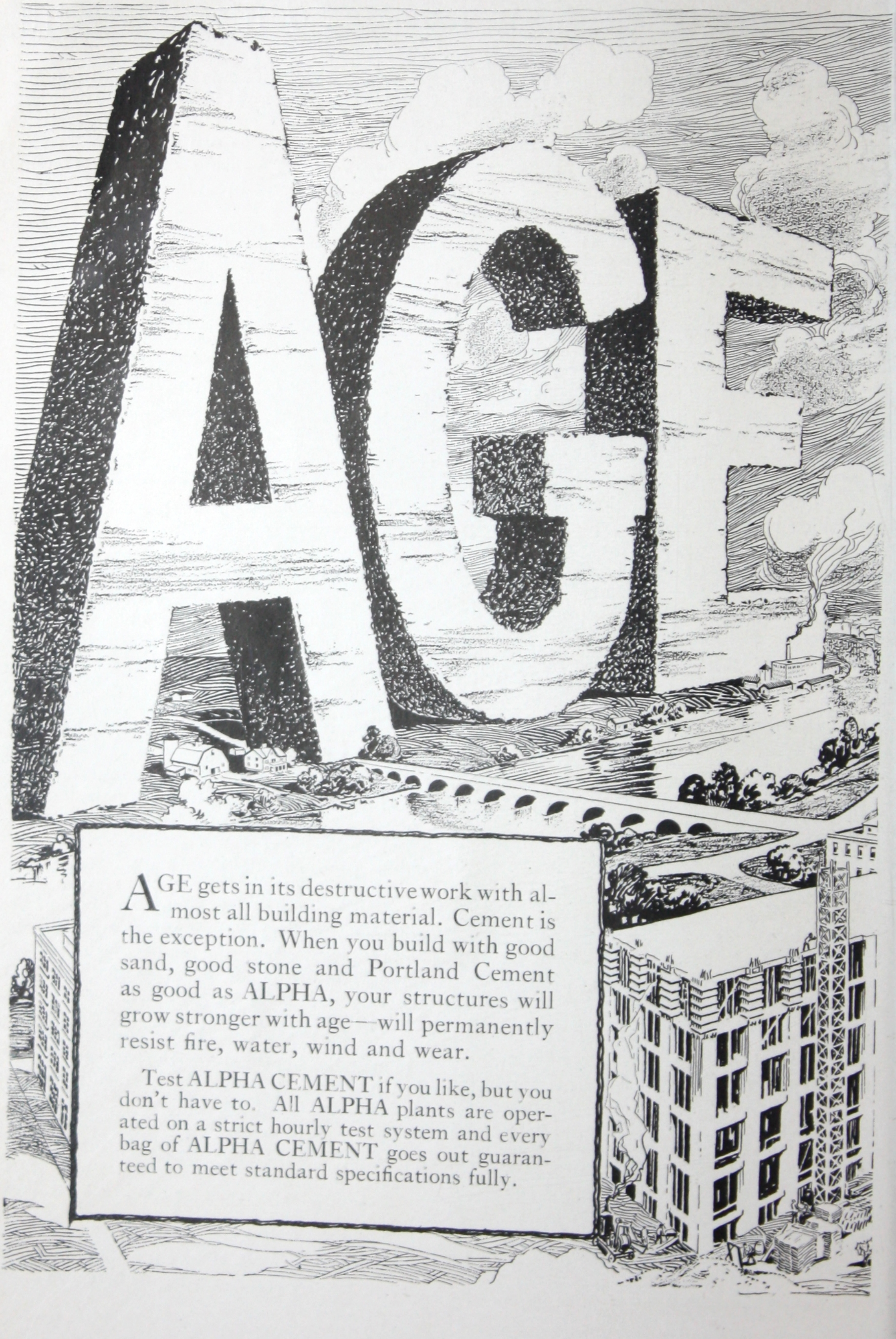
Attractive suburban bungalow of gray cement brick

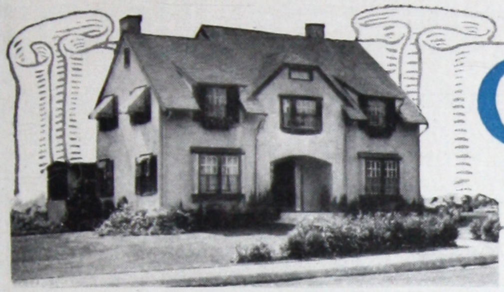
Gray cement brick utilized in a courtway to reflect light

Cement face brick of high quality are now offered for sale in many localities, usually including a splendid variety of colors and textures, some of which, such as greens, blues and variegated shades in stippled, smooth or wire cut surfaces, cannot be obtained in the clay product. Cement face brick now have a large sale for fire places and ornamental interior trim as well as for the usual exterior purposes.

The process of producing the colored facings for cement face brick varies considerably with the type of manufacturing equipment employed. Most tamp process brick machines produce brick "face up," the facing being applied with a small shovel and brought to plane with a wooden float. The colors, either first grade mineral pigments or colored sands, may be mixed in the facing mortar, following the direction for the use of mortar colors given on page 50; in some processes it is "dusted" on the surface of the mortar, and then trowelled. Stippled effects are usually obtained by the use of a stiff brush, quite a variation in results being possible by varying treatment with the brush. "Wire cut" effects are obtained by scratching the surface with a stubby broom or brush, so that the corrugations thus formed appear vertical as the brick are laid in the wall.

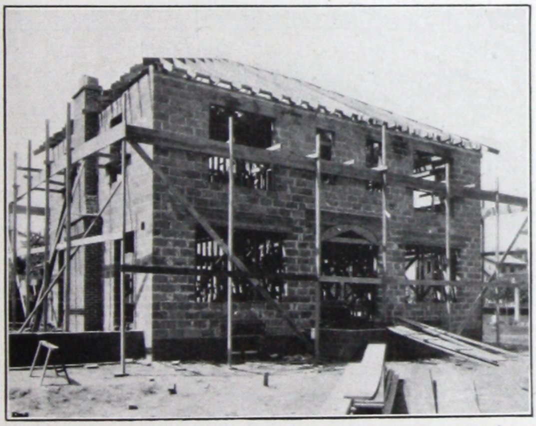
No special directions need be given for the use of cement brick, since they are employed in exactly the same manner as clay brick.


AGE
AGE gets in its destructive work with almost all building material. Cement is the exception. When you build with good sand, good stone and Portland Cement as good as ALPHA, your structures will grow stronger with age—will permanently resist fire, water, wind and wear.
Test ALPHA CEMENT if you like, but you don't have to. All ALPHA plants are operated on a strict hourly test system and every bag of ALPHA CEMENT goes out guaranteed to meet standard specifications fully.



Cement Houses

CEMENT HOUSES, built according to a modern method of construction known as the cement masonry system, are rapidly becoming popular in almost every section of the country. Cement masonry houses are distinguished for moderate first cost, trivial upkeep, slow depreciation, construction features that are exceptional for solidity, dryness, and protection against extremes of temperature and fire. Cement masonry houses not only have structural elegance but they continue to grow more beautiful with age, for the surfacing of artistic cement stucco is perfectly supported on walls of cement block or tile laid in cement mortar. Portland cement stucco clings perfectly to



The cement masonry house, without its "dress coat" of stucco may not be a thing of beauty, but solidity and permanence are revealed in every line

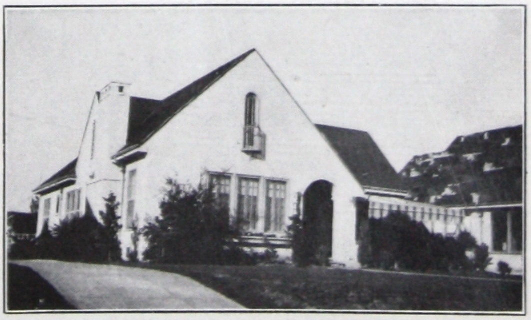
cement block walls—actually becoming a part of them. This is because the two materials are essentially the same and cohesion is perfect.

Many cement masonry houses now being built as well as a large number erected in the past, have foundations and upper walls of cement masonry and the roofs of cement roofing tile or cement-asbestos shingles, the floors, partitions and stairs being of usual wood-framed construction. An increasing number of new houses of this type have

A "body coat" of cement stucco has been applied in preparation for the fine textural finish

cement floors, often with hardwood or linoleum covering, terrazzo or enameled finish or tile insets. Cement floors add greatly to the many characteristic advantages of cement houses, giving a greater degree of protection against fire, rigidity (with consequent reduction of plaster cracks), tight sealing against the passage of dust and smoke and better insulation against sound. Cement floors act like a soap-stone, taking heat from the ceiling below and giving it off on the floor surface above. They are capable of such a wide variety of distinctive treatment as to add greatly to the artistic effect of any interior.

Protection against fire becomes an increasingly important consideration in house construction in cities where dwellings are



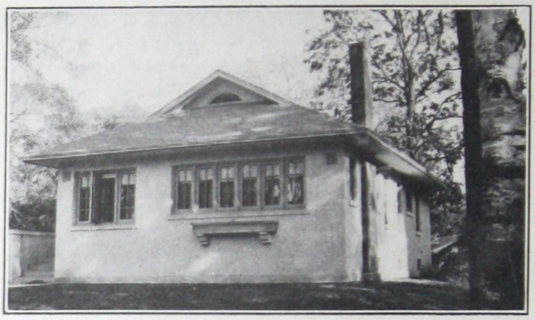
Complete and landscaped, the cement house is prized alike for its permanently beautiful exterior and the entire absence of maintenance expense

built close together and a large population occupies a small area. It is likewise of growing importance on the farm and in rural neighborhoods due to the greater use of gasoline and other oil fuels, electric lighting, inadequate facilities for fighting fire and similar considerations. Today the prospective home owner usually can get reasonably fireproof construction without additional cost by selecting cement masonry; the small difference between permanent and ordinary construction seldom exceeds the cost of a season's painting and repair bills on the latter.

The cross-sectional view on page 45 showing cement masonry house construction indicates several of the many superior features. Foundations or cellar walls are so well constructed that they will always keep out moisture and will not sweat; there can be no settlement cracks or movement likely to affect the walls above. Floor loads are perfectly carried and floors cannot sag. Where wooden floors are used the supporting joists are not only seated on an immovable bearing—they are held rigidly within tightly fitting cement joist block, greatly increasing the rigidity of the floors. There is no sagging to cement lintels and no rotting to cement sills, nor can wind or rain enter around door or window frames. The roof, whether covered with cement roofing tile or cement-asbestos shingles, is designed to give dry covering and to continue serving usefully for a life time or more without necessity for repairs or attention of any sort.

Cement masonry houses have proven delightfully comfortable under the greatest extremes of climatic conditions. In the rebuilding of Halifax after the great munitions explosion during the war, cement masonry was used almost exclusively for hundreds of dwellings and scores of commercial buildings. Hundreds of houses, and many stores and mills were built likewise in the suburb of Morgan Park, Duluth, Minnesota, in a part of the country known for its rigorous winters. Utilizing the experience of the Mexican Indians in building thick-walled huts of adobe to protect them from the heat of the day and the cool of the nights, home lovers of the fashionable southern California

Stately town houses not only attain superior elegance when of cement masonry, but upkeep expense is reduced to a minimum



The bungalow, although unpretentious, may have lasting charm and character if built of cement masonry

Fire Losses

National fire losses have increased every year.

For several years the average loss has exceeded over a million dollars a day.

Present fire loss exceeds $16 per second, or $60,000 per hour, day and night.

The yearly fire loss equals 1000 tons of gold, equalling twice the interest on all saving accounts and would build 100,000 houses costing $5,000 each.

Forty-one persons are burned to death and 47 persons are seriously injured by fire every 24 hours—15,000 people per year are burned to death!

Fire Frequency

1 Dwelling fire every 3 minutes.
1 Farm building fire every 7 minutes.
15 Hotel fires every day.
5 School house fires every day.
5 Church fires every day.
1 Hospital fire every day.

Cement Masonry is Fireproof!

ALPHA CEMENT — HOW TO USE IT

communities are rapidly giving preference to cement masonry over all other types. The remarkable new suburbs of southern Florida —Coral Gables, Hialeah, Hollywood, Cocoanut Grove and others, are being built up mainly of cement masonry—proof that this type has proven beyond question its ability to cope successfully with the Florida climate.

Cement masonry houses are permanently beautiful—in fact more beautiful with age—because they are surfaced with artistic cement stucco applied so that it becomes a part of the cement walls themselves. The surfaces of no two cement masonry houses need be entirely alike as to color or textural treatment. The artistry of hand application —producing individual effects in the play of light and shadow—so that every house is different but harmonious, is responsible for the entire absence of monotony even where there are many cement masonry houses side by side.

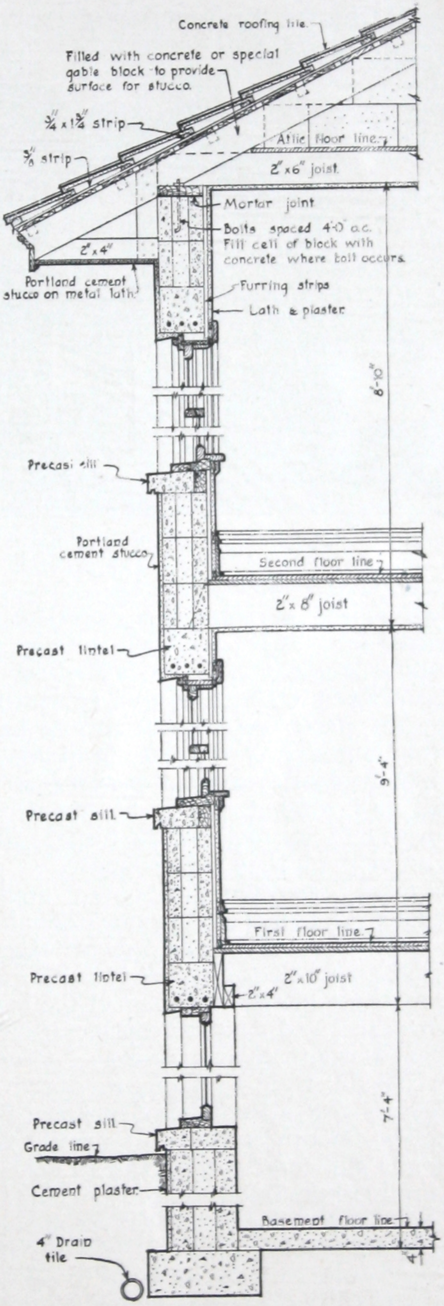
Time merely weathers this beautiful treatment, mellowing and softening it with age. In it is contained the secret of the charm of old country homes, gaining in dignity and beauty as the years roll on. Happily enough, the magic of this treatment may be applied to any style of architecture—with the assurance of pleasing results.

How the House is Constructed. It rarely pays an owner to attempt to build his own house unless particularly well fitted for the task by previous experience. Likewise, it seldom pays an owner to make his own cement block if this material is obtainable from a manufacturer. Every owner should know how his house should be built.

The walls of the house are built entirely of plain cement block (or tile) laid in cement mortar and covered with cement stucco.

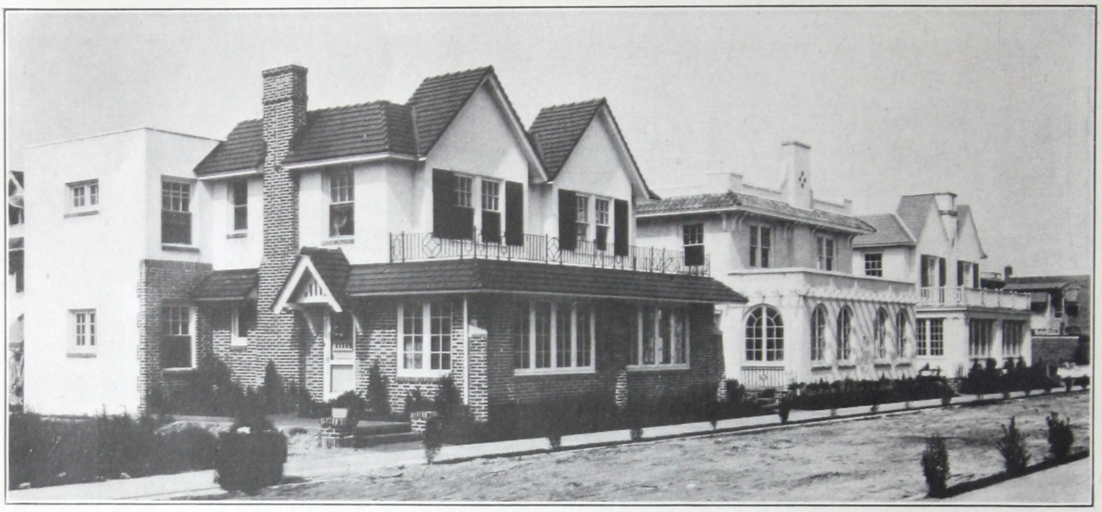
Extreme care is taken when the first course of block is laid on the footing to get it exactly level. Succeeding courses are then laid rapidly until the eave line is reached, interrupted only to set in floor joists, window and door frames.

Either standard aggregate or cinder aggregate block or tile may be used. Since the inside of all main walls is to be furred, lathed and plastered, provision must be made for conveniently attaching the furring strips. This is usually accomplished by embedding in the mortar joints small wooden strips, frequently portions of lath 1½ to 2 inches in length, at intervals of every 3 courses vertically; horizontally they are placed to accommodate the strips, usually 16 inches apart. Wood strips or metal devices for the same purpose should be inserted similarly for attaching wooden interior trim.



Sectional drawing of the cement masonry house. Perfection of design is revealed in every detail

ALPHA CEMENT — HOW TO USE IT



There is no monotony when cement masonry houses are built side by side. The house in the foreground has a veneer of face brick on the lower story

Galvanized or enameled metal lath is preferred for all partition walls, ceilings and area under the eaves, on account of rigidity and superior protection offered against fire. Basement partitions should always be of cement masonry, producing fireproof enclosures, keeping steam and moisture in the laundry (if located in the basement), retaining dust and smoke in the furnace room and providing a rigid floor support.

Cement steps and porches are used so commonly that they are not now thought of as exclusive features of the cement masonry house. Nevertheless, good steps and porches are so important that this part of the building has received special consideration in cement masonry house designs. Cement steps should have surfaces produced by trowelling with a small wooden float; they should be smooth enough to be easily kept clean and still sufficiently gritty to hold the foot firmly to the tread and prevent slipping. The light gray color of cement steps makes them less difficult to see in the dark; they are, of course, entirely immune to rot and decay and the wear is almost nothing.

Cement masonry houses are being designed by the leading residence architects—in many cases even for the architect's own occupancy.

It is noteworthy that cement masonry is the choice where nothing short of the best will do, and as often where limited funds sharply restrict the selection of materials to the least expensive.

Home Builder's Information

Every prospective home builder should obtain and study carefully the following booklets:

"Plans for Concrete Houses" containing 64 pages of practical information on the design of beautiful houses of small and moderate size, also illustrations and floor plans of 40 houses ranging from four to seven rooms in size, prepared by leading architects in various sections of the country. Obtainable from us or the Portland Cement Association, 111 West Washington Street, Chicago, (or nearest district office) at 50 cents a copy.

"Manual of Concrete Masonry Construction" containing complete information on the construction features of cement masonry houses and other buildings. Invaluable as a guide to your architect and builder and as a means of explaining to them just how you want your home built. Obtainable from the Portland Cement Association, without charge, or from The Alpha Portland Cement Co.

"Portland Cement Stucco" explaining methods of obtaining beautiful stucco surfacings. Also obtainable from us or the Portland Cement Association without charge.

ALPHA CEMENT — HOW TO USE IT

Portland Cement Stucco

Portland cement stucco is a mixture of Portland cement, sand and water, often with a small amount of hydrated lime, the latter merely added because it helps to make the mixture "fatter" and in that respect easier to apply. Stucco finishes enjoy wonderful and growing popularity because of the almost infinite variety of individual effects obtainable by the use of colored sands and pigments and through ingenious variation in the methods of application. The illustrations on page 49 are merely typical of hundreds of beautiful surfaces which may be obtained.

Stucco, used as an "overcoating" for old frame buildings, gives them a large measure of protection against fire from without and preserves them against such enemies as rot, decay and corrosion. It cuts maintenance expense such as painting and repairs, makes the building warmer in winter and cooler in summer and if the job is well planned and handled it adds greatly to the appearance of the structure. General suggestions for the use of stucco on wooden buildings, old or new, are contained in the following paragraphs, in addition to which readers are invited to study the more complete information on the subject contained in "Portland Cement Stucco" by the Portland Cement Association.

In placing stucco on a frame structure a supporting frame of furring and lath is necessary. The method in most common use is to apply 1 x 2 inch furring strips, vertically, over sheathing paper, at intervals of 12 inches. Preferably galvanized or painted metal lath (weighing at least 3.4 pounds per square yard) is then attached. Wire lath not lighter than 19-gauge, 2½ meshes per inch, with stiffeners 8 inches apart or wood lath (narrow plaster lath 4 feet long and not less than ⅜-inch thick) may be used. In stuccoing the surface of an old frame building it is usually desirable to leave the old weatherboarding in place, bringing out window and door trim so that they will project slightly beyond the surface of the finished wall.

Although two coat work usually may be used on concrete masonry with entire satisfaction, three coats are necessary for all stucco applied to metal or wood lath.

Applying Stucco to Concrete and Other Masonry Surfaces

"Masonry walls were found to make the best bases for stucco," says a recent bulletin by the U. S. Bureau of Standards, "and on such walls the finest stucco textures can safely be used." Cement block or cement tile walls make the finest base for stucco because they not only provide perfect rigidity, but they produce a wall surface with adequate and uniform suction and mechanical bond, requiring a minimum amount of stucco material to produce satisfactory work.

Cement masonry walls (and those of poured-in-place cement work as well) must be of coarse texture, clean and moist, but not weak or friable. There must be no substance such as paint or dirt on the surface. Two or three coats are usually applied in the process—the first and intermediate coats (if any) being given sufficient body to bring the surface to the plane desired. The finish coat may be quite thin, its function being merely to provide attractive surface treatment. Under coats are usually ⅜-inch to a ½-inch thick. The finish coat varies, but usually need not be over ¼-inch thick.

The stucco mixture should contain 1 part of Portland cement to 3 parts of suitable plaster sand, to which may be added commercially hydrated or well slaked lime not to exceed one-fifth of the volume of the cement. A greater proportion of cement will make the stucco more susceptible to hair checking, while a lesser proportion may produce a mixture not sufficiently watertight. Just sufficient water should be used to give the mixture a good workable consistency. The less water used the better the quality of the mortar, within the limits of workable consistency.

The plastering should be carried on continuously in one general direction without allowing the stucco material to dry on the working edges. If impossible to cover the full width of the wall at one operation the joining should be done at some natural division of the surface. The first coat must cover the base thoroughly, the material being pressed in somewhat to insure a good bond. After it has hardened partially the surface is cross-scratched with a saw-tooth scratcher to provide keyways for bonding the next coat.

ALPHA CEMENT — HOW TO USE IT

Applying the final coat of Portland Cement Stucco

The intermediate coat should be applied as soon as possible after the first coat, this frequently being accomplished by "doubling" or applying the second coat over the first almost immediately. The first coat must be damp when the second coat is put on. A true and even surface is secured by screeding at intervals of not over 5 feet, and by careful use of the straightening rod. After partial stiffening the second coating is dry-floated with a wooden float, which gives it a uniform rough surface. This surface is often lightly scratched in order to give as strong a bond as possible with the surface finish coat.

The final coat is put on solely for decorative effect. The materials are prepared in the same manner as for the under coats with the exception that marble chips, mica spar or specially prepared sand often replace the plaster sand as aggregate. Mineral pigments are also added occasionally in order to impart tints, which add decorative value and if properly mixed may be considered permanent. Deep or vivid shades are not recommended. They are seldom pleasing to begin with, and usually may be expected to weather or fade somewhat. All color mixtures should be mixed according to the directions contained on page 50.

The Portland Cement Association's booklet "Portland Cement Stucco" describes some of the more important stucco surface treatments as follows:

Sand Floated

The finishing coat, after being brought to a smooth, even surface, should be rubbed with a circular motion of a wood float with the addition of a little sand to slightly roughen the surface. This floating should be done when the mortar has partly hardened.

Rough Cast or Spatter Dash

After the finishing coat has been brought to a smooth, even surface with a wooden float and before finally hardened, it should be uniformly coated with a mixture of 1 sack of cement to 3 cu. ft. of fine aggregate thrown forcibly against it to produce a rough surface of uniform texture when viewed from a distance of 20 feet. Special care should be taken to prevent the rapid drying out of this finish by thorough wetting down at intervals after stucco has hardened sufficiently to prevent injury.

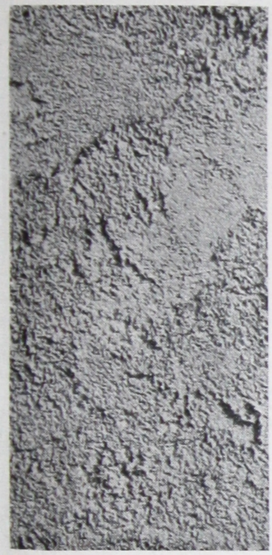
Applied Aggregate

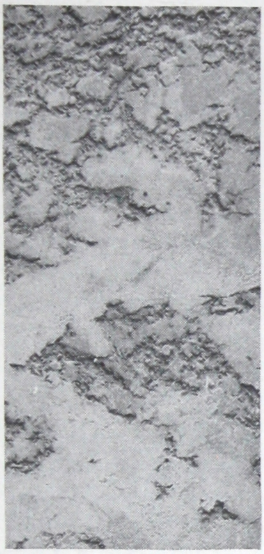
After the finishing coat has been brought to a smooth, even surface, and before it has begun to harden, clean round pebbles, or other material as selected, not smaller than ¼ in. or larger than ¾ in. and previously wetted, should be thrown forcibly against the wall so as to embed themselves in the fresh mortar. They should be distributed uniformly over the mortar with a clean wood trowel, but no rubbing of the surface should be done after the pebbles are embedded.

Exposed Aggregate

The finishing coat should be composed of an approved, selected coarse sand, crushed marble, or granite or other special material, in the proportion given for finishing coats, and within 24 hours after being applied and troweled to an even surface should be scrubbed with a stiff brush and water. In case the stucco is too hard, a solution of 1 part hydrochloric acid in 4 parts of water by volume can be used in place of water. After the aggregate particles have been uniformly exposed by scrubbing, particular care should be taken to remove all traces of the acid by thorough spraying with water from a hose.

ALPHA CEMENT — HOW TO USE IT


Torn float finish


Floated rough cast finish


Special textural finish


Colored rock dash finish

Important Points in Use of Portland Cement Stucco

Workmen

Trust important stucco work only to experienced workmen.

Design

Stucco should be used only on vertical or inclined surfaces where water will drain.

Keep stucco above grade line by running it to a 6 or 8-inch belt course at grade.

The overhang of all belt courses, water tables, sills, and other projections should have drips and steep washes.

Materials

Use only clean, properly graded sand, not more than 5 per cent of which should pass a 100 mesh screen.

Mixing

Measure proportions accurately and stick to them. Use the same proportions for all batches of one coat. Richer mixtures may craze. Lean mixtures will be porous.

Mix sand and cement thoroughly in a mortar mixing machine for two minutes while dry, then for two minutes after water is added.

Use only enough water to produce a plastic mortar that works easily.

Hydrated lime, when used to increase plasticity, may be added dry in quantities up to 9 lbs. to one sack of cement.

Mix only batches that can be applied within 30 minutes.

Placing

Drench the masonry and concrete block walls thoroughly with water, but let drain off before applying the stucco.

Apply the stucco continuously in one direction, and do not let the edges dry up.

Work stucco coats only to an extent that is absolutely necessary.

Keep mortar coats wet for several days. Apply water as soon as each coat has hardened enough so that it will not wash.

Finishing

Apply the finish coat only after previous coats have been cured for at least one week.

Use only wood float to prepare the finish coat for final surface finish.

TABLE 8

MATERIALS REQUIRED FOR 100 SQUARE FEET OF SURFACE FOR VARIOUS THICKNESSES OF STUCCO

Thickness	Proportions 1:2½		Proportions 1:3	
	Cement (Sacks)	Sand (Cu. Ft.)	Cement (Sacks)	Sand (Cu. Ft.)
⅜ inch	1.3	3.2	1.1	3.3
½ inch	1.7	4.2	1.5	4.4
¾ inch	2.5	6.3	2.2	6.6
1 inch	3.4	8.4	3.0	8.8
1¼ inches	4.2	10.5	3.7	11.0
1½ inches	5.1	12.6	4.5	13.2

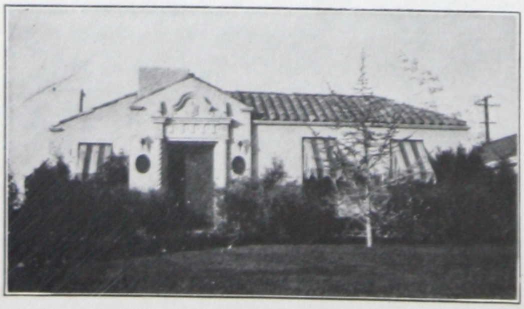
These quantities may vary 10 per cent in either direction due to the character of the sand and its moisture content.
No allowance is made for waste or for keys behind the lath.

Protection Against Drying Out

Because of the exposed positions in which stucco is almost invariably placed, careful attention should be given to insure against rapid drying out with consequent loss of strength. The surface should be kept moist by sprinkling as soon as hard enough to permit such treatment without damage. If exposed to sun, wind or frost, it may be necessary to protect the surfaces with tarpaulins or other suitable coverings for the first two days. A popular method of preventing rapid drying is by covering the surfaces with burlap which is kept saturated with water.

Color Tints for Cement Surfaces

The use of colored sands, or crushed rock offers the best means for obtaining dependable color tints in the surfaces of stucco, mortar, cement products and floors. Where aggregates cannot readily be obtained for the desired shades, first quality mineral pigments may be employed, but organic coloring materials should not be used.



Interesting example of tinted Portland cement stucco

Owing to unavoidable variations in the color of the cement and aggregates, it is impossible to accurately specify by formula the quantities of pigments required to produce certain desired shades. The most satisfactory procedure is to select from the following list the mineral pigment required, then making up small sample panels of the same materials and proportions intended for use in the work at hand. An accurate record is kept of the amount of coloring, cement and aggregate in each trial batch, by weight, so that these proportions may be easily duplicated later. The trial panels are kept moist for 4 or 5 days, then avoiding direct sunlight until quite hard. When fully cured and entirely dry the colors will appear lighter than when wet.

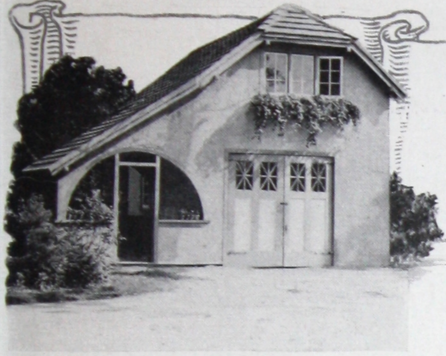
In structural concrete the proportion of pigments to cement is limited to about 10 per cent by weight (9 pounds of color per sack of cement) as greater quantities of color may interfere with the resulting strength. For facings, and the surface coat of stucco, somewhat greater proportions of pigments than above stated are frequently used, without harmful results.

In any mixture containing pigments the mixing must be very thoroughly done in order to perfectly incorporate the color. The cement and pigment are sometimes thoroughly mixed together dry, then added to the mortar mixture in the same manner as the cement is customarily added.

RECOMMENDED COLORING MATERIALS

Color Desired	Pigment
Blue—various shades from light to bright	Prussian Blue or Ultramarine Blue
Brown shades	Burnt Umber or Brown Oxide of Iron
Buff	Yellow Ocher or Buff Oxide of Iron
Grays and Slate Shades	Manganese Black or Germantown Lamp Black
Greens	Greenish Blue Ultramarine Chromium Oxide Mixture of Yellow Ocher and Ultramarine Blue
Red, Pink, Terra Cotta and similar shades	Red Oxide of Iron

For extremely pale tints, such as cream, pure white sand should be used; for absolute white, use white Portland cement and white sand.



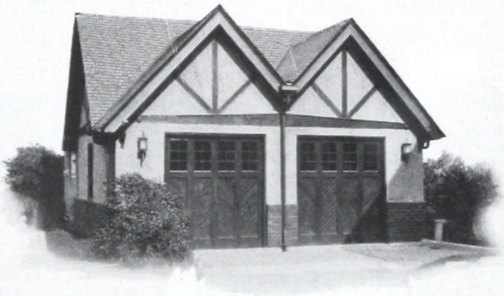
Building a Cement Garage

The garage on the home premises should not only give the owner maximum value in permanence, fire-safety, low maintenance and general security, but it should also be of pleasing appearance, always in harmony with the surroundings. A garage of cement masonry with walls of cement block covered with cement stucco fulfills all of these requirements at moderate first cost and negligible expense thereafter.

Home owners prefer to have a garage on their own premises for convenience, economy and the opportunity thus provided to work about the car. If built of permanent materials the home garage is usually considered safer so far as fire is concerned. A substantial garage is well worth while for it is stronger and therefore less likely to be broken into than structures of the portable or

ready cut kind. The private garage is usually a worth-while investment from another standpoint as well—it provides storage space for tools, equipment and supplies, enabling the owner to buy the latter in quantities where desirable.

While a great many owners are partial to single car garages or cannot in any way make use of more storage room, double garages have become very popular of late because they can be built for only slightly more than the single structures, returning an income from the rental of the extra space. In built up city districts the same idea is often carried further utilizing unproductive rear space for multiple-car or community garages, which provide convenient storage for renters and are usually profitable to owners. Such garages need not be unattractive if properly planned and built of cement masonry.



One of the first questions which confronts the owner is that of size. Single garages should be at least 10 feet in width and 18 feet in length, but a width of 12 feet and length of 20 to 24 feet is preferable, especially for large cars. For trucks, which often have an extreme body width of 8 to 10 feet the garage should have a width of 15 feet. Double garages usually have a width of 20 or 22 feet. Community garages have stall or compartment widths ranging from 9 feet 6 inches to 15 feet, according to type of storage. If only pleasure cars are to be stored the stall width need never exceed 12 feet. Ample space in the garage costs little and is usually very convenient for storage.

Cement masonry garages are so simple in construction that few directions are re-

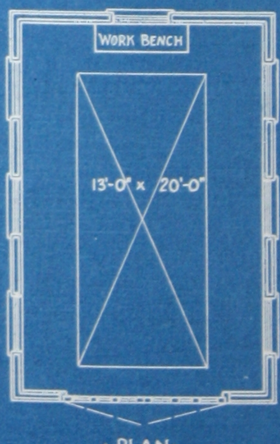
AN INEXPENSIVE ONE CAR GARAGE

BILL OF MATERIALS FOR CEMENT WORK

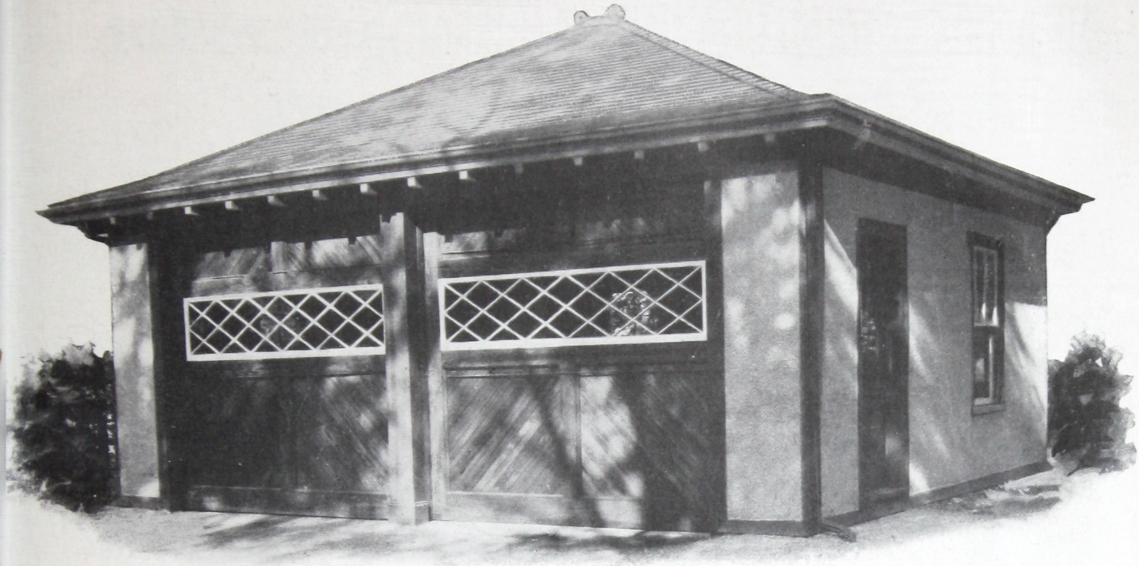
ALPHA Cement	33 barrels
Sand	11 cu. yds.
Stone	20 cu. yds.
¼" reinforcing rods	1200 lin. ft.
½" reinforcing rods	50 lin. ft.

· FRONT ELEVATION ·

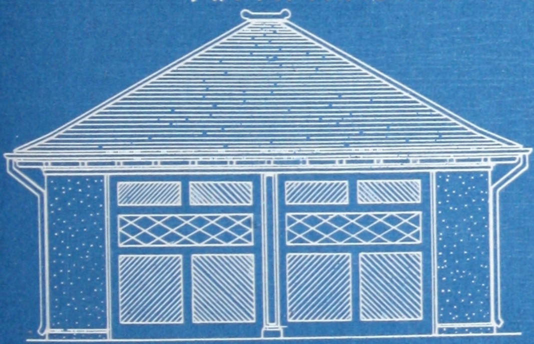
· SIDE ELEVATION ·



· PLAN ·



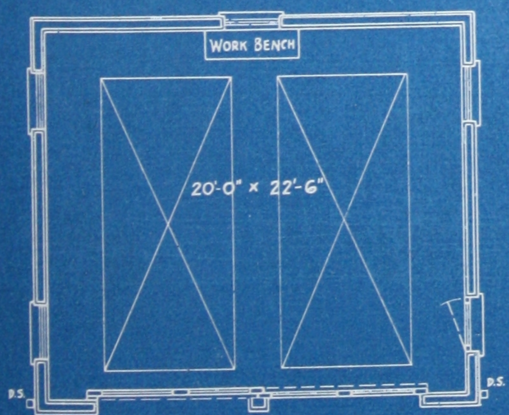
AN ATTRACTIVE TYPE *of* TWO-CAR GARAGE



FRONT ELEVATION

BILL OF MATERIALS FOR CEMENT WORK

ALPHA Cement	38 barrels
Sand	13 cu. yds.
Stone	22 cu. yds.
¼" reinforcing rods	1200 lin. ft.
½" reinforcing rods	90 lin. ft.



PLAN

SIDE ELEVATION

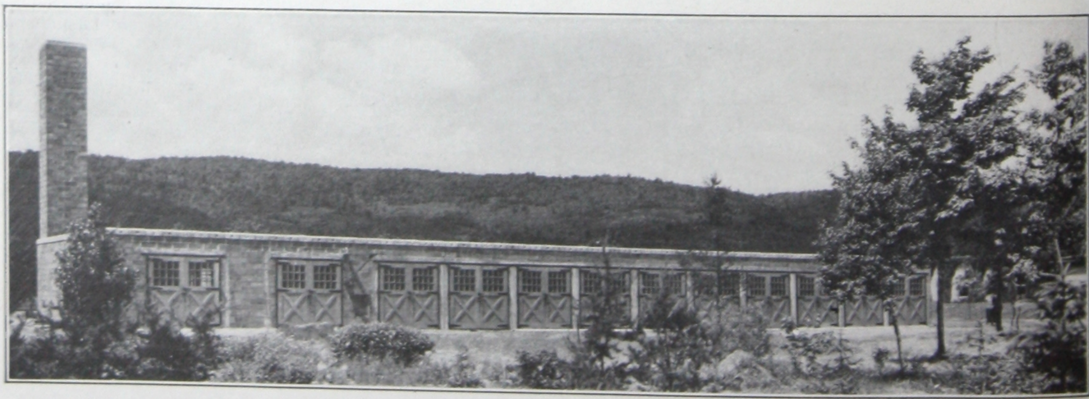
For ease in entering and leaving, every community garage should be provided with a cement driveway

quired for their successful erection. The footing is built just as for a cement masonry house—except narrower—in an excavation carried below the frost line. Under ordinary soil conditions the footing width need be only 12 inches and the height 8 inches. The block or tile are then laid in a cement mortar bed or footing, carefully leveling and squaring the first course. Subsequent courses, to the eaves, are then quickly laid in the usual manner.

A cement floor is a necessity. It may be constructed to drain to an outlet in the center or at some convenient point within the garage. Some owners prefer to slope the floor toward the large doorway, so that moisture drains directly to the outside. This method eliminates the possibility of escaping gasoline accumulating in sewer traps.

If the garage will house only pleasure cars the concrete floor need only be 3 inches thick; if trucks are to use it, the thickness should be 4 inches. A mixture of 1 part cement to 2 parts sand and 3 parts screened gravel (pebbles) or broken stone may be used for the entire floor thickness, placed at one time. The floor may be laid in one slab covering the entire surface of a one or two car garage, or may be divided into four slabs approximately 10 feet by 10 feet each.

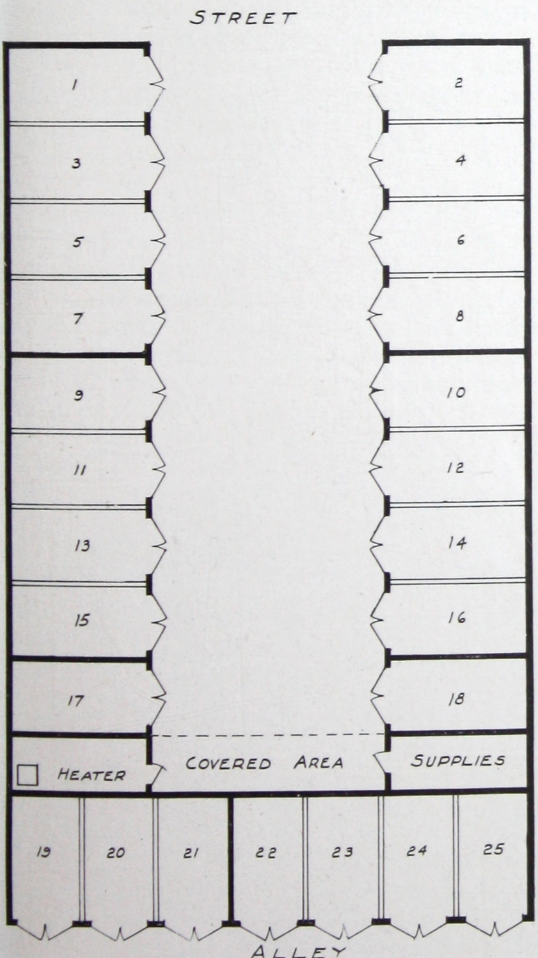
If the ground has been disturbed or a fill made, it is advisable to compact the surface, or even to cover it with a few inches of cinders, which are well compacted, before the floor is laid. The same procedure is even more necessary in the case of the approach slab. This is sloped at an easy angle in order to run off water and to afford smooth passage in and out of the garage. The approach is frequently made by continuing the floor



Community garage with cement masonry walls and cement roof. Fire-resistant and maintenance-free construction

ALPHA CEMENT — HOW TO USE IT

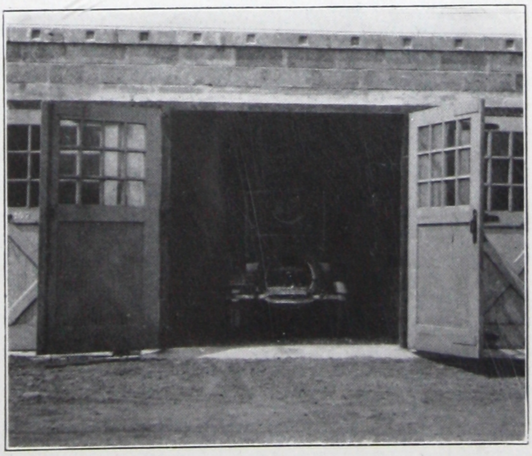
An "Automobile Apartment" is what the community garage really is



Two floor plans for community garages

out beyond the building line, giving it the required pitch. If this practice is followed it is very necessary that adequate drainage be provided by placing a well compacted layer of cinders or gravel, at least 6 inches deep, under the slab.

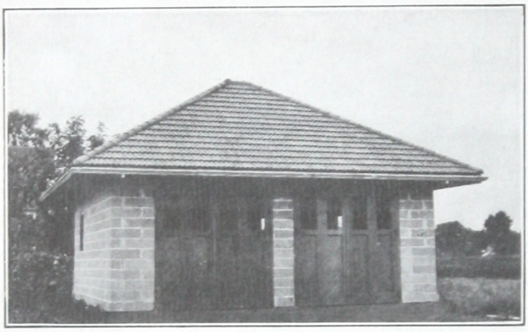
The garage roof is usually made to conform to the type used on the residence, although not necessarily the case. The most economical satisfactory method of building at the present time is to use cement-asbestos shingles or cement roofing tile over a wood frame, ceiling the under side including eave underhang, by the use of cement plaster applied to metal lath.



An automobile in one of the convenient stalls of a community garage

Economical Community Garages

The community garage is beginning to make a place for itself in the residential sections of our cities. It combines many of the advantages of the individual private garage with those of the public storage. In principle the community garage resembles many single garages placed side by side, with heating arrangements and other facilities in common. It often represents the most economical use of space for automobile storage purposes and in many localities offers an excellent opportunity for investment.



Ready for the stucco coats. Roof of cement roofing tile

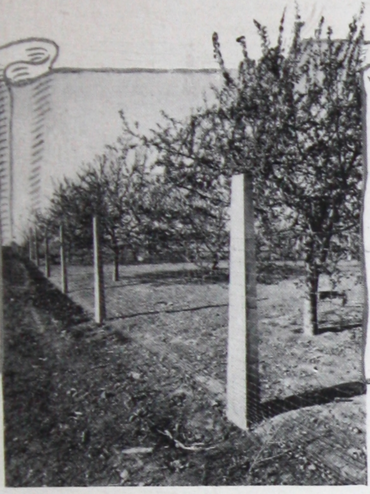
To reduce the fire hazard as well as maintenance, the community garage should be built of cement construction. A very large number of structures of this kind have been built recently with walls of concrete masonry construction, using ordinary cement block covered with Portland cement stucco or flat-faced block without stucco. If the garage is well located and some little attention paid to planting vines and shrubs around it a decidedly attractive appearance is secured not objectionable in the best communities. If desired, the garage may be entirely concealed.

The views on pages 54 and 55 suggest several good arrangements for garages of this class.

From two to four stalls are usually grouped together in a single compartment, the stalls then being separated by cement block walls to a height of 3 feet, above which are partitions of heavy galvanized wire, extending to the roof. This arrangement is much more economical than earlier types dividing individual stalls with solid masonry walls, still preserving most of the protection benefits and preventing loss of heat throughout the garage should a door be left open in cold weather.

Each stall has its own doors, lights, water closets and bench. The heating pipes are usually carried in a small depression in the floor along the side of the building opposite the doors. A curbing is formed around this depression in the floor to keep out water and dirt. All doors are fitted with individual locks, to which the janitor has a master key. Each stall may be provided with a slate on which the car-owner leaves directions for cleaning or other service desired, and by this method his car is ready for instant use.

A commercial garage of cement masonry, fireproof throughout, attractive and able to cope with the hard usage demanded of structures of this kind



Cement Posts

Fence Posts, Corner Posts, Gate Posts, Inclosure Walls

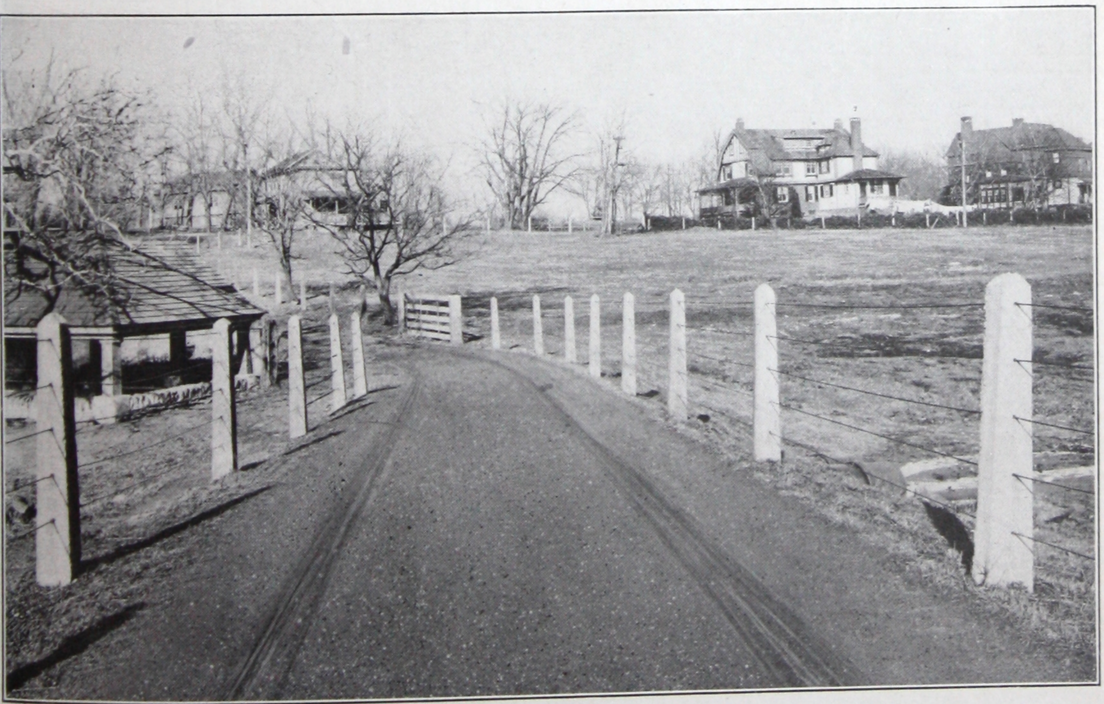
KEEPING fences in good condition is no easy task where the material in the post needs constant care and repair. Even the best wood posts will burn, rot, get out of line, break under heavy strains, or wash out in a flood.

The cement fence post is everlasting. It keeps in alignment and can resist unusual strains without breaking. In some sections its first cost is no more than for a good wood post, but everywhere cement posts are cheaper in upkeep than wood posts. No repairs, no painting; they grow stronger each year.

In comparing the advantages of cement and wood fence posts, the U. S. Department of Agriculture, in Farmers' Bulletin No. 403, has this to say:

"After three years' service wooden posts possess only from one-third to one-half of their original strength, whereas concrete grows stronger with age and needs no repairs, for neither weather nor fire injures it.

"Cement posts are attractive in appearance because of their uniformity in size and color and, because of the durability, they effect a saving in giving greater life to the fencing material used, so that the permanent value of the property is increased."



Cement fence posts on farm of Haverford College, Haverford, Pa. Made with ALPHA CEMENT

CONSTRUCTION · OF ·
AND ·

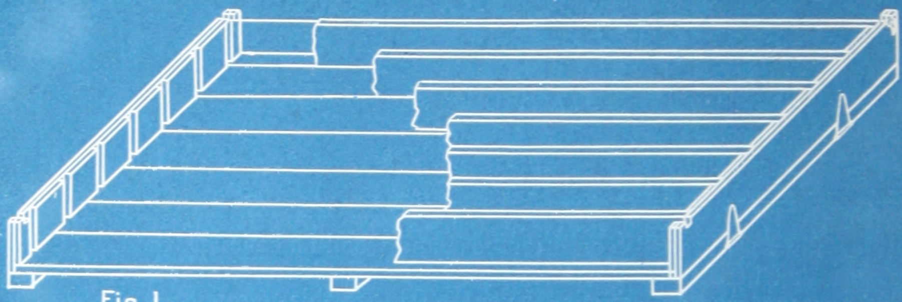


Fig. 1.
Gang mold for Concrete fence posts without taper

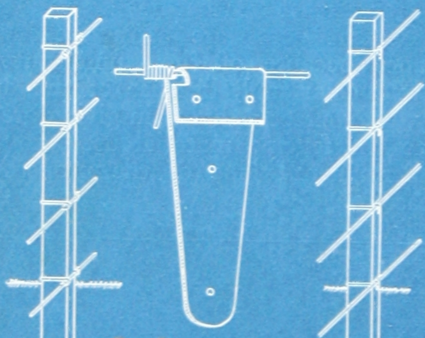


Fig. 5.
Two methods of attaching wires to concrete fence posts. A hinge may be used to twist wire ties, as shown.

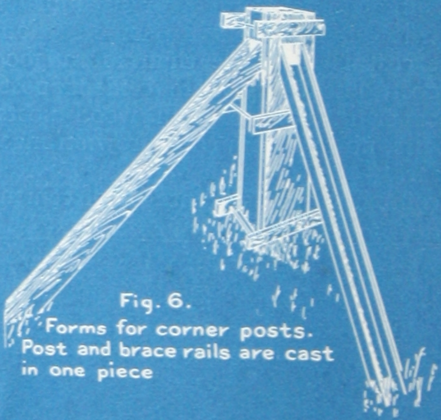


Fig. 6.
Forms for corner posts. Post and brace rails are cast in one piece

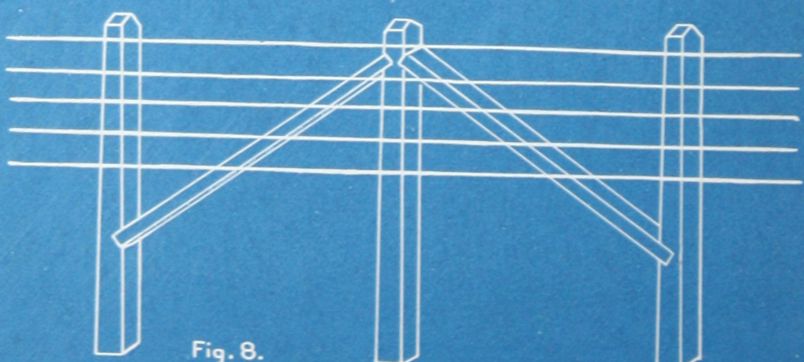


Fig. 8.
Method of bracing fence line every thirty posts. Principle is same as in Fig. 7.

CONCRETE · POSTS · INCLOSURE · WALLS ·

Fig. 2.
Proper position for reinforcing rods in various types of concrete fence posts

Fig. 3.
Wire spacer used for holding reinforcing rods in place.

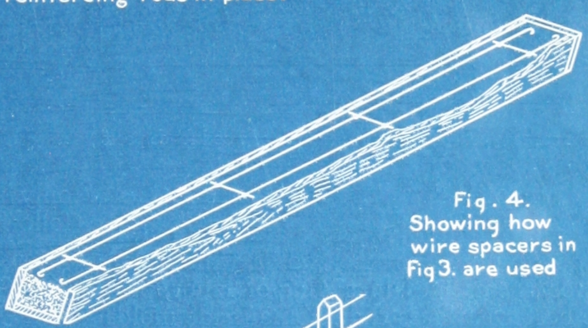


Fig. 4.
Showing how wire spacers in Fig 3. are used

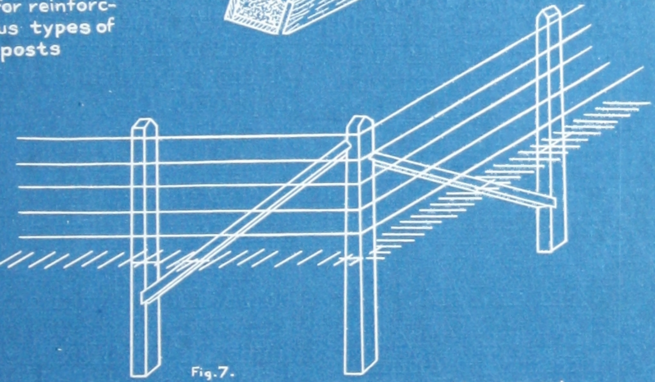


Fig. 7.
One method of bracing corner posts. Mortises are cast in corner and brace posts. Concrete brace rails are inserted in mortises as shown.

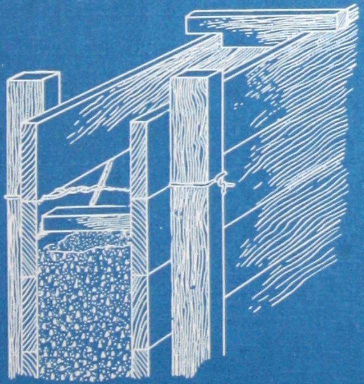


Fig 9.
A common method of spacing and tying forms for cocrete walls.

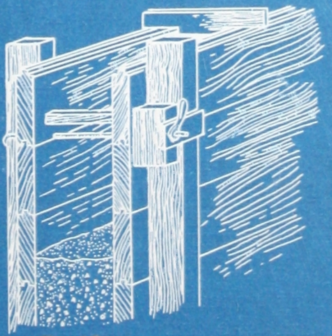
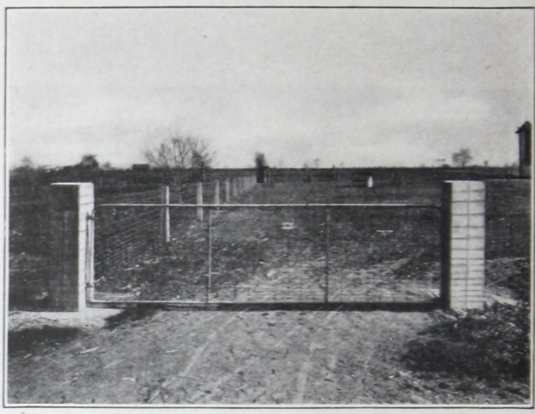


Fig. 10.
The rod and clamp method of holding wall forms in place

Cement corner posts add years to the life of wood fence posts



Cement posts prevent gates from sagging

Molds for Cement Posts

If more than a few posts are required, it will pay to purchase steel molds, which soon pay for themselves in saving of labor, produce better surfaces than home made molds and last a lifetime. In case home made wooden molds are to be used, the rectangular shape will be found easiest and cheapest to produce, making the molds in gangs casting from 4 to 10 posts at a time. For ordinary fencing no post should be smaller than 3 inches square at the top and 4½ inches square at the bottom.

Reinforcing Cement Posts

Since strains on a post may come from any direction, it is necessary to distribute the reinforcing to all sides of the post as indicated on the preceding page. One big rod in the center will not do. The size of rods depends upon the size of the post. Ordinary $\frac{3}{16}$-inch to $\frac{5}{16}$-inch diameter rods will suffice. Wire of proper size may be used but rods are more economical. They must always run the full length of the post, extending as far down in the ground as the post goes. To hold reinforcing rods in place while concrete is being placed, wire spacers are used. These spacers are of No. 16 wire twisted as shown in Fig. 3 on page 59, and used as shown in Fig. 4. Three or four spacers are used to a rod. Note, too, that the ends of rods are turned back about an inch.

Molding Cement Posts

Molds should be treated as suggested on page 24. Concrete for posts should be mixed only in quantities enough for immediate use, following directions on pages 10 to 20.

After the molds are filled to a depth of ¾ inch to 1 inch, two reinforcement rods, properly placed, are laid in. The molds are then filled to within ¾ inch to 1 inch of the top, when the remaining reinforcing is placed. They are then filled to the top.

As soon as the molds are filled, they should be tapped or moved up and down quickly from the corners. This will release the air bubbles and make the concrete more compact.

The exposed corners of the post may be beveled off with an edger and the open face given a smooth finish with a trowel immediately after the surface water has been absorbed and before the concrete has become too hard.

Curing Cement Posts

After being placed, concrete should be left in the mold two or three days to harden. When the end pieces and partitions of the mold are removed, the posts should be left on the bottom board in the shade for a week or ten days, and protected as suggested on page 20. After ten days, posts may be moved outdoors and piled as wood posts are piled. They should be handled with great care, as a slight drop may break a fresh post. Jarring may cause cracks, invisible at first, but seriously weakening.

Cement posts may be used when thirty days old, but not sooner.

Cement Corner Posts. Corner posts stand heavier strains than line posts, and

should therefore be braced properly. They are generally made from 6-in. x 6-in. to 12-in x 12-in. square without taper. The exact size is determined by particular needs. Reinforcing rods range from $\frac{9}{16}$-inch to 1-inch.

On account of their weight and consequent inconvenience in handling, posts larger than 8 inches square are generally cast in place. A hole dug in the ground is filled to the ground level with concrete. Forms are put in position and filled with concrete. If the ground is not firm, forms should be set below as well as above ground.

In corner posts like that in Fig. 6 on the blueprint, the large base of underground part is built of concrete made with field stones in assorted sizes. Unless corner posts are so massive that they will stand in their own weight, they must be braced. (See Figs. 6, 7 and 8 on the blueprint.) Braces as well as posts, must always be reinforced.

Posts may be made monolithic with braces, or posts may be notched or mortised about 8 inches from the top on the sides where the bracing is necessary. Brace rails are cast in molds. One end of the brace rail is inserted in the notch of the post, and the other end inserted in a similar notch near the bottom of a brace post. (See Fig. 7 on the blueprint.) A brace post is heavier than an ordinary line post.

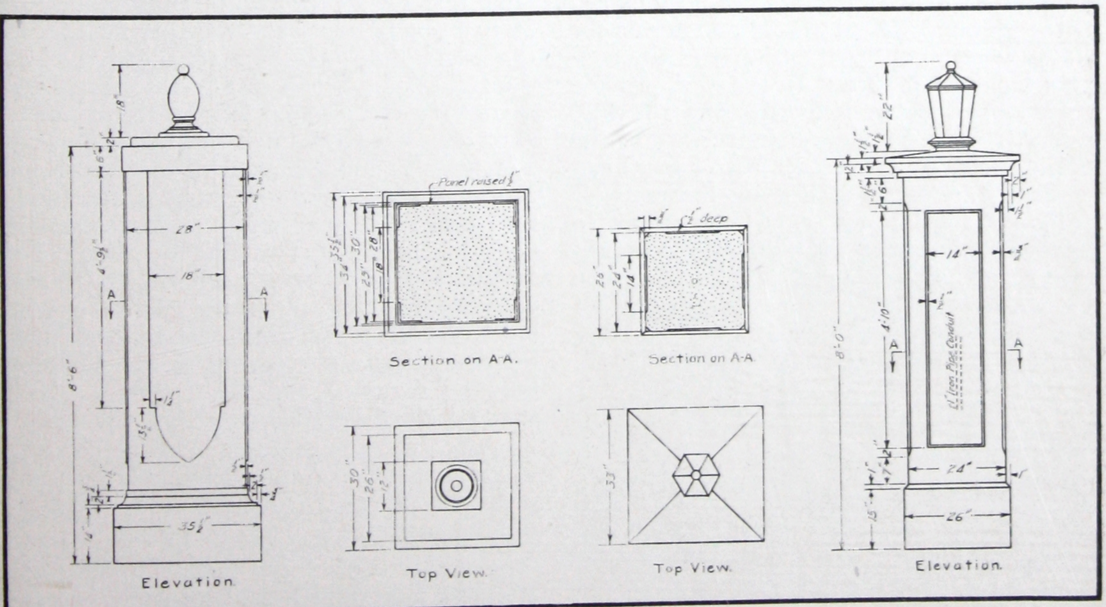
In a fence it is well to brace about every thirtieth post. To do this it is necessary that the thirtieth post, and the post on each side of it, be a little heavier than the rest in order to support the brace rails.

Gate posts and hitching posts are made in the same manner as corner posts. Holes for bolt hinges are sometimes made by inserting a piece of gas pipe in the fresh concrete. Sometimes a hinge with a clamp strap that entirely encircles the post is used. Gate post should be braced unless they are made massive enough to withstand the strains. There is no limit to the many artistic effects possible to secure with concrete in the making of gate posts.

Cement Inclosure Walls

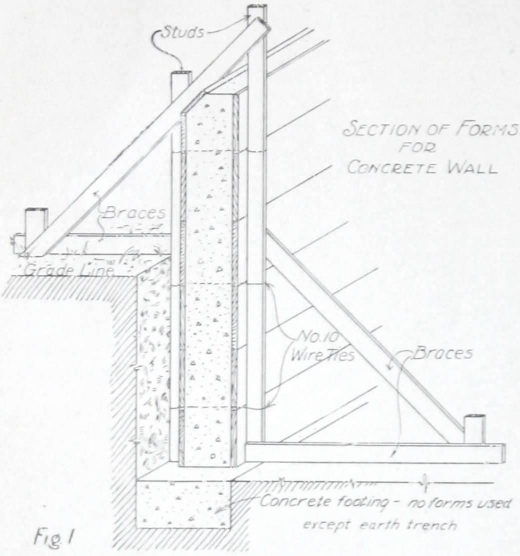
Cement walls are more attractive and more lasting than any other inclosure wall. They need no repairing or painting and are therefore economical.

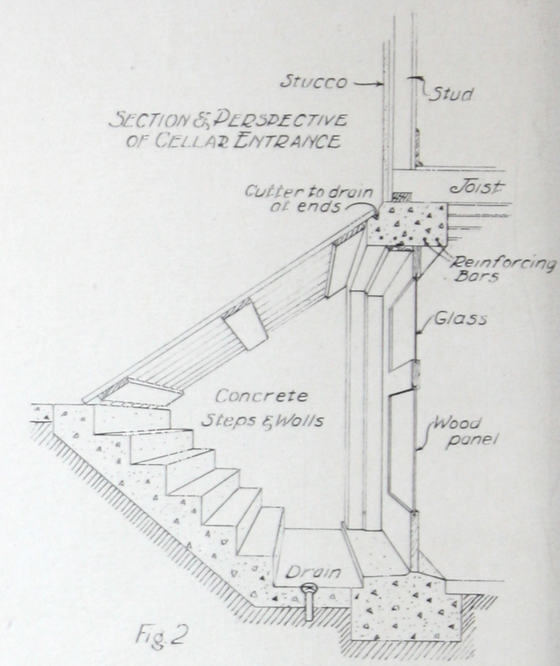
The principles of construction are very much like those for house walls (see pages 21 to 25). An excavation deep enough to carry the foundation below the frost line is filled with a 6- or 8-inch layer of broken stone, cinders or brickbats, and then filled to the ground level with concrete.



Good designs for cement gate posts. Footings for these posts (omitted from sketch for convenience) are started at a level below frost penetration, same dimensions as at grade

ALPHA CEMENT — HOW TO USE IT





Foundations, Walls and Steps

Fig. 1 illustrates in section and perspective forms for a cement foundation wall. It will be seen that the footing has been placed in the trench without forms and forms for the wall set up on the footing after the concrete has become firm. In order to provide a good bond between footing and the wall proper, it is well to leave the surface of the footing quite rough, in fact better bond can be secured by partly embedding in the upper surface of the footing rough field stones so that when concrete for the wall is placed bond can be secured with these stones. The text in this book under the heading of "Forms and Reinforcement" gives a number of excellent ideas on foundations.

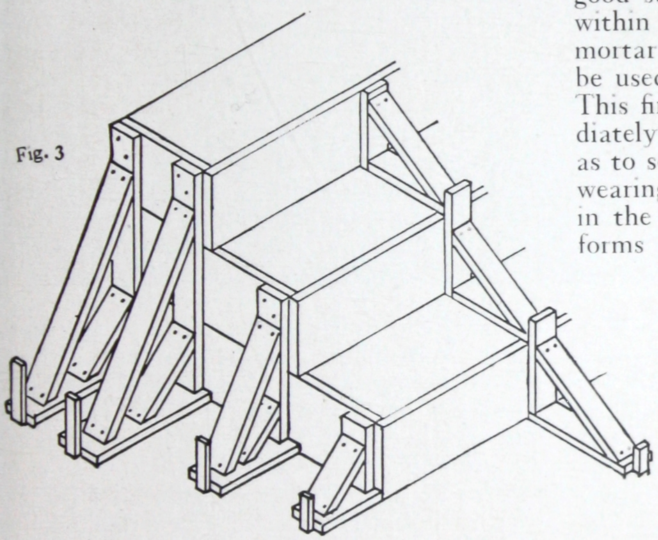
Foundations Under Old Buildings. A complete cement foundation can readily be built under an old building. All that is necessary is to remove from the old wall a few of the stones or bricks as the case may be, at various points around the foundation and insert short pieces of heavy timber to wedge up the building. The building should be carefully raised in this manner entirely clear of the old foundation. Then all of the old foundation should be removed and a trench dug and forms set in place in the usual manner for concreting. In case of small buildings it is usually easy to raise them high enough to allow working room, in which case the forms can be filled right up to the top with concrete. If the building is large and too heavy to be raised readily so as to provide necessary working headroom, the foundations may be made 3 inches wider than the sill. When the forms have been carried to the desired height the concrete may be inserted through this extra space of 3 inches. To make placing of the first layers of concrete easy the top board of the forms may be left off until ready to place the last layer of concrete. The building should not be lowered upon the foundation until the concrete has had at least two weeks to harden. After this time the timbers used for the purpose of wedging up the building may be removed and the openings which they occupied be filled with concrete.

Cellar Steps are shown with construction detail in Fig. 2. While side retaining walls may be built before or after cellar steps are constructed, it will usually be found more convenient to place the forms for the steps after the side walls have been built.

Before laying the concrete for the steps the slope on which they are to rest must be

well compacted so that there will be no settlement and consequent cracking of the concrete. If there is any doubt as to the sustaining power of the soil it would be well to lay a 2-inch layer of concrete first on this slope and then to embed in it ¼-inch rods placed 12 inches center to center, after which concreting of the steps may be continued. This reinforcing will serve to prevent cracking at the relatively thin section of the concrete where the tread and the rise meet.

Fig. 3



Construction of forms for cement steps, showing proper method of bracing

Retaining Wall and Steps

Terraces if too steep, will not stay sodded, and if too flat take up room which would otherwise be a part of the lawn. The neatest way is to place a retaining wall along the terrace edge.

If the wall is over 1 foot high steps are necessary. A most convenient arrangement is to have the bottom step come flush with the face of the wall, making it impossible to fall over one or two projecting steps in the dark.

In building, insert a stop plank between the front and back forms to prevent the concrete from going to the full height of the wall. The bottom of this plank should be kept at a height above the bottom of the wall sufficient to form the first step.

After the concrete for the wall is placed, remove the section of the form where the steps are to come, and dig out the earth to a depth sufficient to hold them. The remaining steps are built in the manner already described.

Fig. 3 gives suggestions for constructing simple forms for outside steps.

Cement steps can readily be built of a uniform concrete throughout provided the coarse aggregate does not exceed ¾ inch in greatest dimension, and the concrete is well spaded when placed in the forms. If there is any difficulty encountered in getting a good surface finish, forms may be filled to within about ½ inch of full and a 1:2 cement mortar in which the sand is coarse and hard be used to fill the remainder of the forms. This finishing coat should be placed immediately after placing the other concrete so as to secure a good bond between base and wearing surface. If any irregularities appear in the face of the risers of the steps after forms are removed, these can be readily pointed up with a 1:2 cement mortar and be finally given a coat of cement grout paint if a smoother finish is desired, this being gone over with a trowel just as soon as the grout has commenced to harden.

The illustration below is a suggestion of how individuality can be attained.

Paneling of various kinds is easily arranged by the use of blocks and strips in forms.

ALPHA Service Sheets on cement retaining walls and steps are free. They will be of help to you.

Side form for steps, showing how a little decorative line can be easily introduced

The entrance of this trim-looking cement storage cellar may be planned by the method shown at top of page 62

Walks and Floors

So far as the operations of construction go, there is little difference between cement walks and cement floors laid on the ground. Cement floors such as laid for the various stories of a building above ground level, are necessarily reinforced and, therefore, involve the observance of some principles of construction not associated with similar work supported by soil foundation. The following discussion is not intended to in any way consider the building of reinforced cement floors.

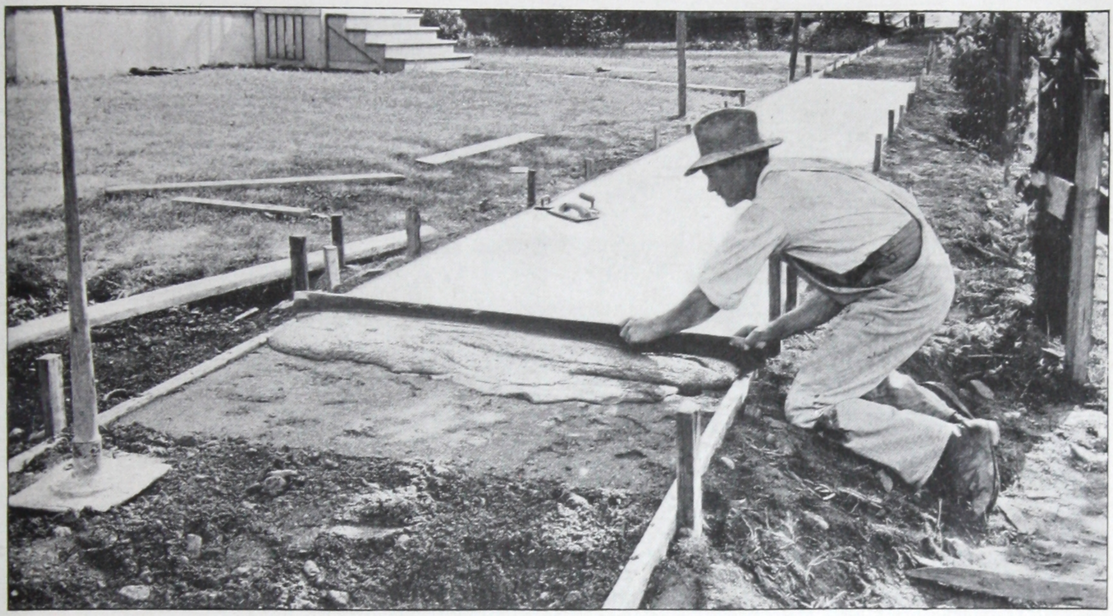
A cement walk is a stretch or strip of concrete intended primarily for pedestrian traffic. It may, however, be compared to any cement pavement. The first essential to success in the building of walks and of floors on soil foundation is that the soil shall be well drained so as to prevent water from being retained beneath, thus preventing the upheaval in freezing weather. The area on which the concrete is to be laid should be cleaned from all vegetation and similar refuse, and if the soil is not firm so as to provide a substantial foundation, it should be thoroughly compacted by rolling or tamping so that everywhere bearing power will be equal. All soft or spongy spots should be dug out and filled with clean gravel containing little or no sand or with hard cinders free from ash, and such filling should be well compacted. It is desirable, however, to avoid the use of any such filling material where effective drainage in the natural soil can be secured because

Good type of barn driveway. By adding side walls and a cement floor an excellent cold-storage room could be had

Cement Block in Foundations and Walls. For large structures and particularly where it is desired that the foundation or wall be of massive character, no doubt monolithic construction is to be preferred, but for a great deal of foundation work, particularly that type appropriate for dwelling houses and other small buildings, cement block may be and often are used to advantage. Where cement block are available, the labor and expense of setting up and taking down forms is eliminated and the resulting cement work is just as satisfactory in every way as though monolithic cement construction were used. There are ordinarily fewer pockets than in monolithic concrete and presents an attractive appearance.

The laying of cement block being essentially masonry work, comparable to the laying of brick and dimension stone, a few precautions different from those one would call attention to in connection with monolithic construction are necessary when cement block are used for building foundations. It is always desirable that basements be dry and there is no reason why basements enclosed by cement block foundation walls cannot be made and kept just as dry as though the enclosure wall were of monolithic construction. All that is usually necessary is to make sure that the block used are of good dense mixture and that they are laid in a rich sand cement mortar not leaner than 1:3, that the block are well wetted before laying and that the mortar joints are completely filled with mortar and well pointed up. As an extra precaution the treatments described on page 34 may be applied.

ALPHA CEMENT — HOW TO USE IT



Leveling surface of sidewalk by use of straight-edge

the tendency is, when using a subbase of gravel or cinders to place it in what amounts to a trench and in that way provide a "sink" or sump hole which serves not to drain the foundation but to actually cause water to collect and be retained beneath the finished pavement. Therefore, if a subbase of cinders or gravel is used the added precaution should be taken to lay tile drains to lower outlets at such intervals as will secure free drainage of the subbase.

In order that the surface of a walk or floor may drain quickly after rains, it is necessary that the surface have a slight gradient or slope in one direction or as is sometimes done in the case of a walk, have the surface very slightly crowned. One-quarter of an inch to the foot is sufficient slope to provide for a floor and not to exceed one-quarter inch crown at the center of a walk of usual width (4 feet) will provide all necessary drainage slope for its surface.

Outdoor floors and cement walks may be either of one or two-course construction. For feeding floors, barnyard pavements, driveways and ordinary walks around the farm, one-course construction is preferred. For such work a 1:2½:5 concrete may be used. In the case of feeding floors or barnyard pavements where greater density and hence, dampness or penetration of filth is to be prevented, a 1·2·3 mixture is preferred.

Generally speaking, no sidewalk should be less than 5 inches thick. The same may be said of floors, except if the latter are to be used in part as driveways and, therefore, will be subjected to the weight of heavy traffic, the thickness should be greater and in most cases reinforcement in the concrete will be desirable.

Depending on the thickness of the pavement, 2 by 4's or 2 by 6's will serve for forms. These should be held rigidly in place by stakes or braces with top edges true to the line and grade required. Where sidewalks fill the space between curb and building lines, forms should be so set as to give the walk a slope toward the curb of ¼-inch per foot of width. Where walks are bordered by lawns, forms should be set level and drainage of the walk secured by suitable crown at the center. One-quarter inch for each foot from side to center is the maximum necessary. Walks and outdoor floors may be built by so setting forms that alternate slabs are concreted first and when these have sufficiently hardened forms can be removed to permit concreting of intermediate slabs.

Present-day practice in building walks has, however, run toward continuous concreting of the strips and joints are provided for by division plates used where desired to mark the limitation of slabs or by cutting

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through the entire thickness after it has sufficiently hardened so each slab may be completely separated from adjoining ones. Where division plates are used, they are usually of 1/8-inch thick steel as wide as the depth of the slab and as long as the width of the walk. They should be thoroughly cleaned and oiled each time before and after use. After the concrete has hardened sufficiently to prevent breaking, the division plate can be removed without difficulty.

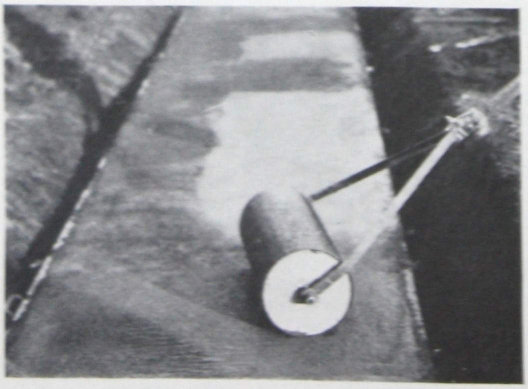
Concrete is usually mixed to a rather stiff consistency that will require rather vigorous working to bring to proper surface. After placed between forms it is struck off to the required level by using a template or straight edge. The subgrade where concrete is laid should be dampened just before concrete is placed upon it. If dividing plates are not used to mark the limitations in slabs, every care must be taken to see that in cutting through the concrete to mark a joint it is completely cut through so that slabs are separate. The surface edge of each slab should be rounded to a radius of 1/4-inch by using one of the common finishing tools intended for that purpose.

In walks, expansion joints should be used to take care of changing volume of the concrete due to temperature changes. Expansion joints should extend from the surface to the subgrade, be truly at right angles to the sidewalk surface, and be made by putting the specified joint filler in place before placing the concrete. The joint filler used in such cases is generally a premolded asphaltic preparation similar to that used in joints in other cement pavements such as roads and streets. The expansion joints should be placed at approximately 50-foot intervals and should be about 1/2 inch thick.

No other detail of cement pavement construction is of more importance than proper curing of the work after actual concreting is finished. In the case of cement walks, however, this precaution for some unaccountable reason is almost universally neglected. As a result sun and wind dry out water from the concrete before that water has had a chance to perform one of its principal objects, namely, the chemical transformation of the cement which results in thorough hardening of the concrete. Specifications for cement highway pavements require that a covering of earth or some other moisture-retaining covering be placed on the pavement as soon as practicable to do so after having placed the last concrete and further require that such covering shall be kept in place and moist for varying periods in order to enable the concrete to thoroughly and uniformly harden.

If the construction is to be two-course work, then a base consisting of 4½ inches of 1:3:5 concrete may be used with a finishing coat of 3/4-inch mixture of a 1:2 cement mortar. It is necessary that the fine aggregate used in the wearing course mixture shall be hard and durable in order to resist the wear of traffic.

The latest practice in cement walk construction follows a practice in highway pavement construction that has become general in the past two or three years, namely, the use of a light roller to compact the concrete immediately after it has been stuck off in the forms and before the final finish is given by a wood hand float or



Use of roller in finishing one-course sidewalk construction

An example of failure to provide for tree growth, resulting in upheaval of slab. A semicircle should have been left in the slab when laid

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Improper drainage is sometimes the cause of cracking of walks at the center. Often, however, such cracking is due to the area on which the concrete is laid being slightly higher at the center than at the sides; that is, compacted more at the center than at the sides, with the result that the slab rests on this hard center and lacks support at the sides

trowel. It is recommended that a roller for this purpose be from 10 to 12 inches in diameter and so built that its weight is approximately one pound per linear inch of surface contact.

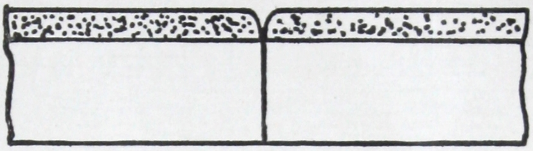
Generally speaking, cement walks should consist of slabs not greater than 6 feet long in any dimension. Indoor floors such as those used in barns and stables should be laid in slabs not greater than 10 feet in any one dimension unless the concrete is reinforced.

"Dusting" of Floors. Frequently we hear complaints of cement floors dusting badly. The cause of this has been definitely fixed in the use of too fine or dirty sand, soft sand, too lean a mixture, coarse aggregate coated with dust or clay, dirty material of any sort, too much troweling when finishing with a steel trowel, having the cement mixture too dry or too wet and neglecting to protect the work after finished.

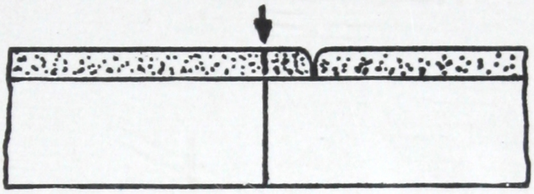
Knowing the causes of dusting, the remedy is evident, namely, be sure to avoid those bad practices known to contribute to the undesirable end.

Read the directions in preceding pages of this book covering testing of sand, proper mixing, methods of securing density and waterproof quality.

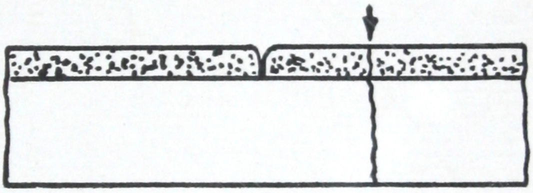
Cement improvements advertise the fact that progressive people live thereabout



(a)



(b)



(c)

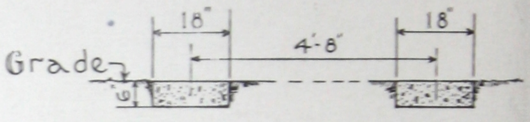
(a) Sidewalk slab division, properly made, through base and top courses

(b) Where joint in top course is not over joint in base. Result, crack at point indicated by arrow

(c) No division in base. Result, base may crack, carrying crack through top course, regardless of division in top course, producing crack in top as shown by arrow

In two-course work the top is frequently not laid soon enough following the placing of the base, with the result that sooner or later the top course scales or breaks away from the base. Frequently the top course is too thin and also, as mentioned in the accompanying text, the base often contains so little cement as to have no excuse for being called concrete

Curbs and Driveways



"Strip drives" are made according to the dimensions shown

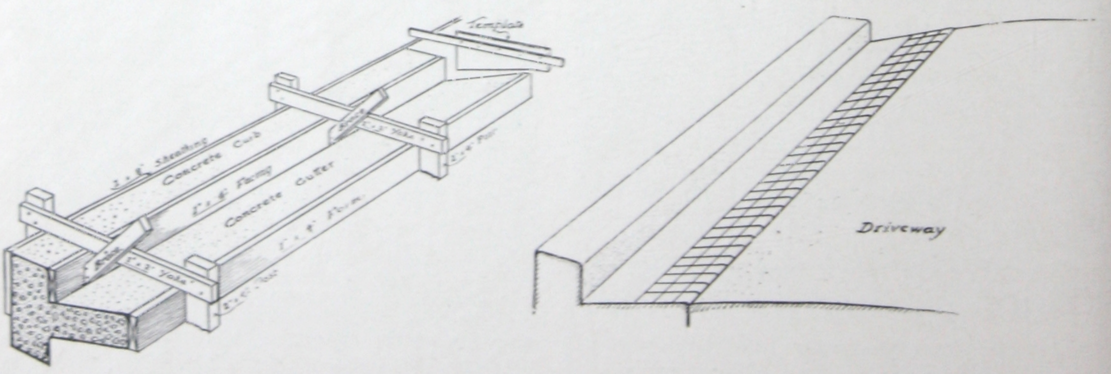
To build a fine cement walk or driveway without protecting the edges with curbing would mean the formation of irregular and disfiguring gutters established by nature, if not the undermining of the structure. The additional expense of adding curbing while the work is under way would represent a small outlay compared with its value. It is a simple matter to construct substantial cement curbing. When properly done it will not get out of alignment as is the case with stone curbing. It may be brought to an exact line and finish, thus corresponding in texture and appearance to the thing it protects. Cement construction is used for this purpose in all large cities and towns, and in response to the great demand for curbing of this character, machinery has been invented to facilitate construction. The same good results, however, may be secured where the work is done by hand. A standard method of constructing ordinary curbing, such as would be suitable for the farm or a suburban property, might be described as follows:

At the edge of the pavement, and measuring from its finished surface, dig a trench 12 inches deep and at least 6 inches wide. Place over this the forms, the bottom of the forms being on a level with the finished surface of the road. Make the forms about 6 inches high. The forms should be placed both back and front of the proposed curb, the front form having a batter or incline of ½ inch. Concrete should then be deposited in the ditch and within the forms, and the upper surface smoothed off with a steel float and all small surface interstices filled in with a 1:1 mortar in case this is necessary. The upper edge should be rounded with a 1-inch rounding tool so as to give a neater appearance. The moment the concrete is sufficiently hard not to pit under sprinkling, this should begin and the concrete should be kept wet for at least two days. The more frequent and prolonged the sprinkling of the newly-finished work, the better the results.

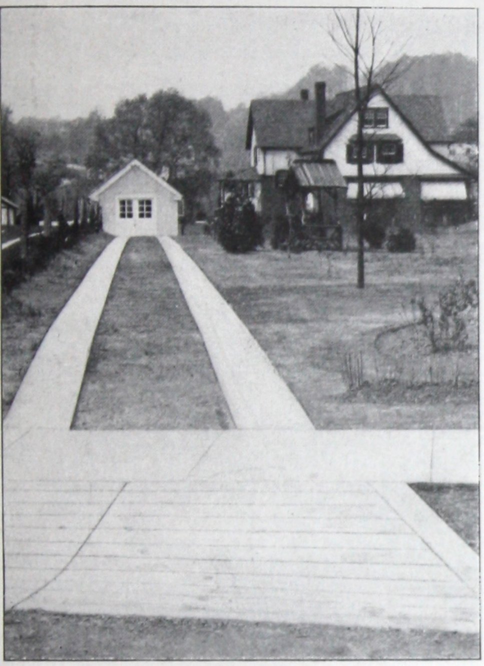
Cement Driveways

The cement driveway is reasonable in first cost, and if well built, will last indefinitely. Even on highways subject to constant traffic of all descriptions, cement has proved to be more satisfactory than any other material of like cost. For example, a cement road put down in Bellefontaine, Ohio, some twenty-five years ago has cost less than $25 per mile per year for maintenance during that long period of time. On a private driveway of concrete up-keep cost should be practically negligible. It is in recognition of its durable and economical properties that many owners of large country estates are substituting cement construction for macadam and other types of roads.

In building a driveway to a house to provide for private automobile or service



Sectional view of cement curb before and after removing forms



A method of saving concrete in an automobile runway

traffic which is seldom excessive, lay the concrete 5 inches at the sides and 6 inches at the center. This thickness will be amply sufficient for such infrequent traffic. The proportions should be 1:2:4. The concrete should be mixed to a mushy consistency and when in place between side forms, which should be rigidly staked at each side of the road, proper shape should be given to the road by means of a template, a long plank reaching from side form to side form, and cut to the desired crown. After bringing the road to proper contour by the use of the template the surface should be evened up by lightly troweling with a wooden float. When the concrete is sufficiently hard not to pit, the surface should be sprinkled with water, and when the concrete will stand the weight of a man, it should be covered with about 2 inches of earth, which should be kept wet for at least ten days. No traffic should be allowed upon the road for two weeks. Cut at every 25 or 30 feet what are known as expansion joints. These expansion joints should be filled with asphaltic felt or tar paper. Where the driveway receives very heavy loads, such as hay wagons and large trucks, make the concrete 6 inches at the side and 8 inches at the center, mixed in the proportions of 1:2:3. Otherwise the method of construction is the same as already described, with the exception that the edges of the joints should be protected by special steel plates.

Cement Tracks for Automobiles

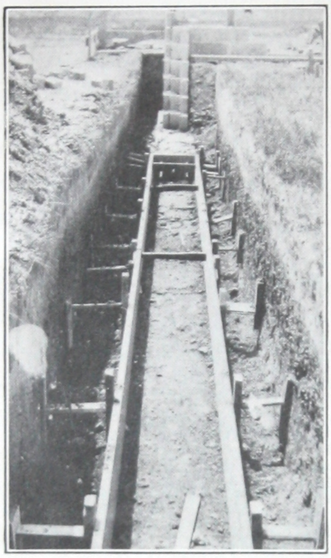
In some cases property owners possessed of small lots have adopted a rather ingenious method of making cement roads for automobiles by digging trenches and establishing therein narrow cement tracks as shown in the accompanying illustration. This type of construction is not practicable where vehicles pass each other.

Small Cement Buildings

Strength, permanence and freedom from repairs and constant expense are just as much a part of small cement houses as large ones. Small cement buildings include chicken houses, icehouses, hog houses, machine sheds, smoke houses, garages, dairy buildings and other similar structures.

In a way, all well constructed buildings are built by following certain so-called "specifications," and except as it is necessary to vary certain details of a specification to provide for different foundations so that the weight of different sized buildings will be properly carried by the soil, one broad, general specification can be made to include most, if not all, of the requirements of construction.

Foundations for Small Buildings. The first thing necessary is to excavate foundation trenches below the line of frost penetration and to such a depth that firm soil may be reached, to provide the necessary load-carrying capacity. A foundation so constructed will not be subject to heaving from frost action or settlement due to improper bearing, and, therefore, will not crack. Foundation depth to avoid frost usually may be obtained by inquiry to a local builder or some other person familiar with successful building practice in the neighborhood. All roots, sod and any other refuse material must be removed and any soft or spongy spots must be excavated and holes filled with well compacted gravel, cinders or earth.



Placing footing and cement block foundation wall

Bearing Area of Soils

The bearing area for different soils is commonly calculated according to the following table, which may be used for foundations, footings, piers, engine bases and similar work:

Soft Clay—1 to 2 tons per square foot of bearing area.
Ordinary Clay—2 to 3 tons.
Dry Sand and Clay—3 to 4 tons.
Hard Firm Clay—4 to 6 tons.
Firm Coarse Sand—6 to 8 tons.
Firm Coarse Gravel—6 to 8 tons.
Bed Rock—15 tons.

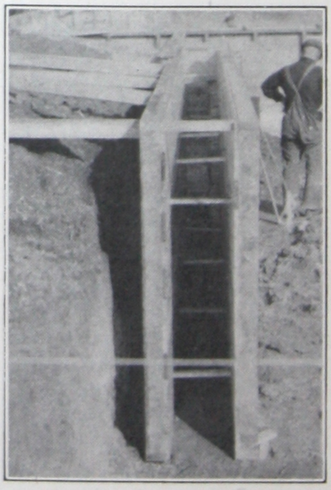
The Floor. For convenience, the floor is often constructed immediately after completing the foundation walls to ground level; otherwise it is built after the walls have been finished and the structure practically enclosed. In any event, the floor must be constructed entirely separate from the walls and a joint must be provided between them, in order to permit unequal settlement without cracking.

In preparing the subbase for the floor all holes must be filled and compacted to avoid possibility of settlement.

Walls. Cement block or cement building tile, which are now easily available almost everywhere, constitute the very best wall materials for small and moderate sized buildings on the farm and elsewhere. For all small buildings hollow block or tile 8 inches in width are preferable; for the lower walls of large barns blocks 12 inches in width are used in order to provide amply for the heavy loads carried. Methods of using these materials for the walls of small buildings are described on page 40.

Where cement block or tile cannot be had conveniently the walls may be built of monolithic or "solid" construction. Walls so built need not be over 6 inches thick for the average small building, and where limited to one story in height, a wall thickness of 5 inches is usually sufficient if the wall lengths are not over 30 feet. In such case pitched roofs must be provided with their own cross bracing, to make sure that no outward thrust is transmitted from the roof to the walls.

The foundation for a small building should start on a cement footing 12 inches wide and 8 inches deep, placed at the required depth. (See paragraph on Foundations page 64.) The 8-inch cement block may be laid on this and continued to the roof as illustrated on page 39. If the wall is to be built of concrete mixed on the job, forms may be set directly on the footings and the wall continued up of equal thickness from that level. In many cases, however, where a basement is not desired, the wall below grade is placed without forms in a trench dug as narrow as practicable, frequently about 10 inches. In such cases



Forms in position for monolithic foundation wall

the saving in avoiding excavating and the use of forms justifies the use of more material in the wall below grade.

Proportions will be found in the Tables of Recommended Mixtures on page 12.

When laying foundations upon which wooden structures are to be erected, it is always advisable to embed anchor bolts in the concrete so that the wood sill may be firmly anchored to the concrete. This in turn serves to anchor the whole building against possible destruction from heavy winds if the timbers are well framed into or fastened to the sills by stud anchors. Where sills are not used, such stud anchors are themselves attached to the cement foundation by bolts previously embedded in the concrete at the time the last few inches of the foundation is constructed. See illustration on this page. These bolts are held in the position desired while doing final filling of forms, by suspending them from hangers resting across from inside to outside forms.

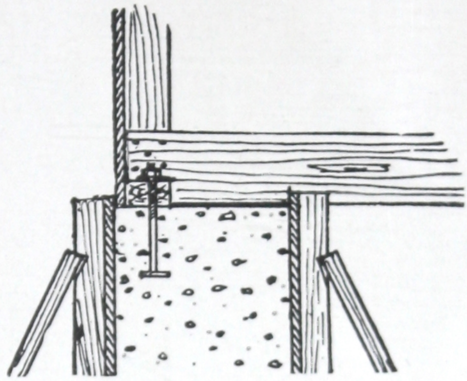
Roofs

Cement roofs, like other cement structures, reduce fire risk by eliminating the hazard of fire. Reinforced monolithic and a plastered cement roof formed on a base or ground of metal fabric are used both for pitched and flat roofs. Usually the cement roof is designed after the slab type with but little pitch.

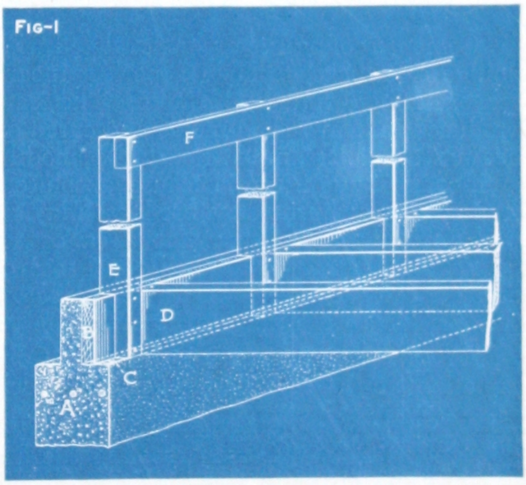
Fig. 5, page 23, is an example of a typical slab roof.

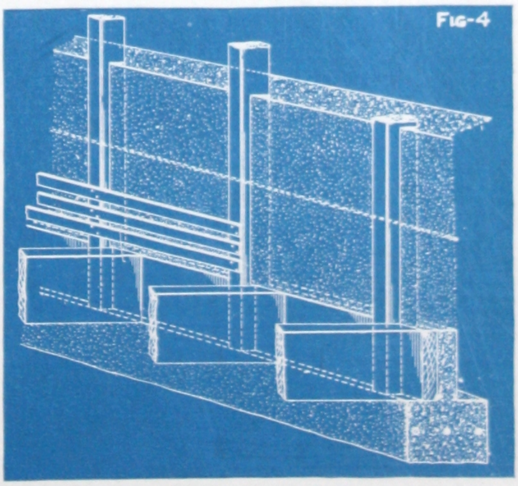
Cement Roofing Materials. Where pitched roofs are desired and the unsupported spans are rather great, it is sometimes difficult to place cement slabs or plastered construction such as described in the preceding paragraph, and preference easily leads to the selection of cement roofing tile or cement-asbestos shingles where a permanent, fire-resistant and maintenance-free roof is desired. Either of these roofings will be found attractive, easy to lay and equally applicable to new or old roofs.

Rigid "asbestos" shingles, made by a process of pressing a rich mixture of asbestos fibre and Portland cement, are often preferred to slate for finest roofing purposes and should not be confused with flexible "prepared" roofing.



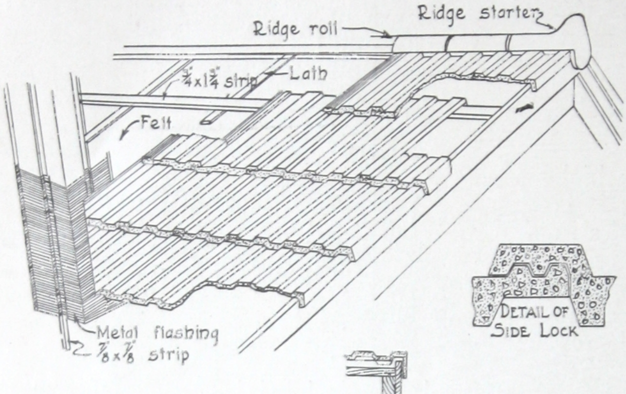
Method of inserting bolts in last few inches of cement foundation so that sills may be secured tightly





A good method used in wall construction of a cement house. The wooden studs are left embedded partly in the concrete. The slight interior projection of the studs makes furring and a dead-air space easily possible

ALPHA CEMENT — HOW TO USE IT



Typical details of cement tile roof

Cement roofing tile are constructed with double side locks, forming a perfect means for excluding wind and water. They are produced in heavy steel molds and cured on heavy steel pallets, making each tile smooth-laying and snug-fitting because absolutely true to shape; burnt clay products may be warped or twisted somewhat as a consequence of heat treatment. Both types of cement roofings are procurable in colors suitable for a wide range of uses.

"A Manual of Concrete Masonry Construction" by the Portland Cement Association, says:

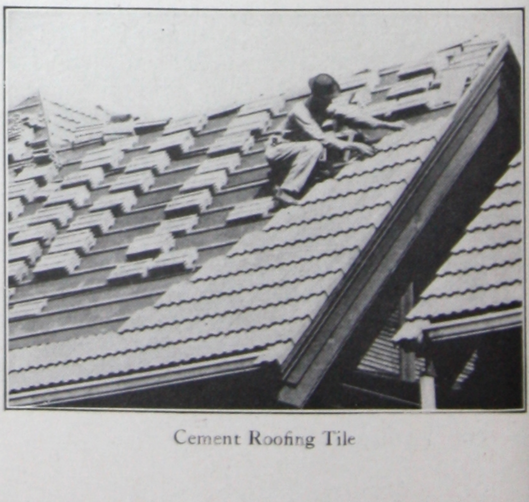
Cement Tile. "Cement roofing tile are generally produced in standard sizes of $9\frac{3}{16}$ inches by $14\frac{3}{4}$ inches (overall dimensions,) 150 tile being required per square of 100 square feet. Their weight is approximately $5\frac{1}{2}$ pounds each. Typical construction details of cement tile roof are presented in accompanying illustrations. The supporting rafters should not be less than 2 by 6 inches in size, spaced 20 inches apart, center to center, connected with collar or tie beams to prevent spreading and covered with 1-inch seasoned sheathing, close laid and firmly nailed. With the aprons and counterflashing raised to admit the felt, the laying of the roof is done in this manner:

"Cover sheathing with approved 12-pound, or heavier, roofing felt laid parallel to the eaves and lapped at least half its width in every course. Lay an extra ply of felt next to the eaves; cap the hips and ridges with an extra longitudinal strip at least 12 inches wide and extend the felt up against vertical walls at least 6 inches under counter-flashing. In valleys lay one extra ply longitudinally.

"Lay continuous lath weeper strips on 18-inch centers from eave to ridge at right angles to ridge. Attach to the weeper strips and at the right angles to them, $\frac{3}{4}$ by $1\frac{3}{4}$-inch battens (accurately spaced to accord with the length of the tile). Lay tile carefully so that when finished the courses will present a straight and uniform appearance when viewed vertically, horizontally or diagonally. Cover hips and ridges with accurately laid ridge roll, bedded in 1:3 cement mortar colored to match roofing tile."

Cement Asbestos Shingles. Cement asbestos shingles are approximately $\frac{3}{16}$-inch thick. They average in weight about 435 pounds per square (100 square feet) for the American (rectangular) type and about 275 pounds per square for the French, or diagonal, type. The method of laying is substantially the same as for common wood shingles except that conveniently shaped "specials" are provided for use at ridges, valleys and eaves.

Protection of Ceilings and Eaves. A protective covering of Portland cement plaster on metal lath may be expected to delay the passage of flames for an hour, and afford an effective protection against moisture and decay. Therefore, the underside of every wooden-framed roof should be protected by the application of cement plaster on metal lath to the ceiling and under-hang of the eaves.



Cement Roofing Tile

Cement Poultry Houses

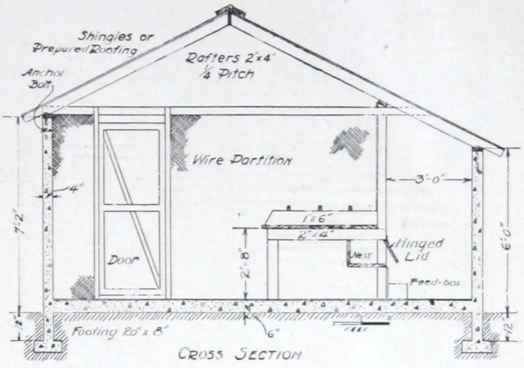
Hens can be made to produce large quantities of eggs and maintain such a production if they are provided with suitable quarters and are otherwise well cared for. Sanitation is a large part of success in poultry raising. Good cement construction in a poultry house will improve sanitation by checking vermin and other poultry pests.

Foundation requirements are included in the chapter on "Small Cement Buildings." (Page 69.)

This design, which is for a cement poultry house 16 x 45 feet, may be halved if desired, without varying any of the construction requirements.

This poultry house plans ventilation from open windows covered with 1-inch poultry mesh and protected against extreme cold weather by muslin drop curtains. Dampness on walls of poultry houses can be avoided in the same way as in dairy barns and that is by proper ventilation.

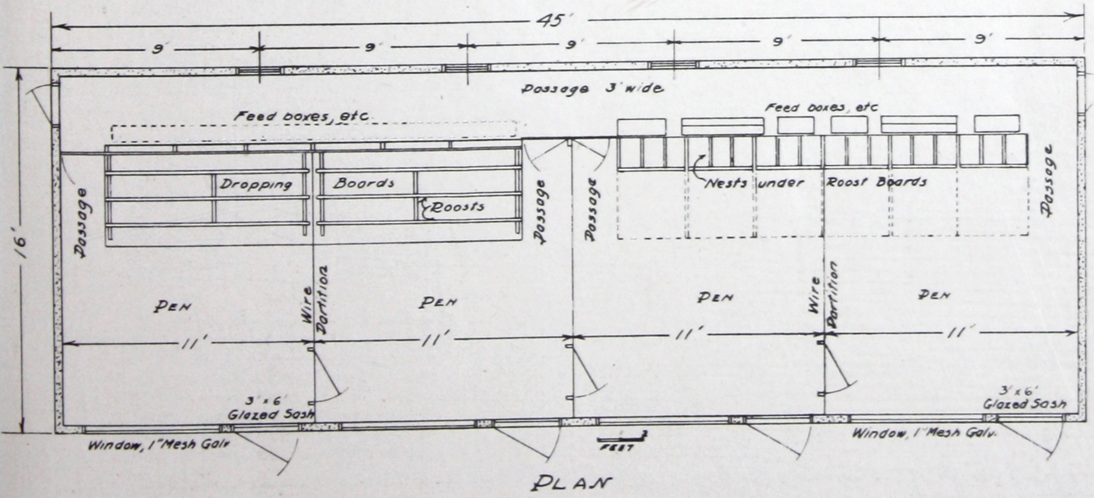
Cement poultry houses are rat-and mouse-proof. Where the poultry house floor must necessarily be located on soil which is not favored with the best of drainage, then it is well to prepare a subbase on which to lay the floor. This should be preferably 8 inches of well-tamped, clean gravel, or cinders free from ashes, and this subbase should be connected at several points to tile drains that will prevent water from remaining beneath the floor. The floor should be of one-course construction, using a 1:2:3 mixture, and should be graded so that rain driving in will drain off. On this floor there can be thrown any kind of clean litter for the animals to scratch in.



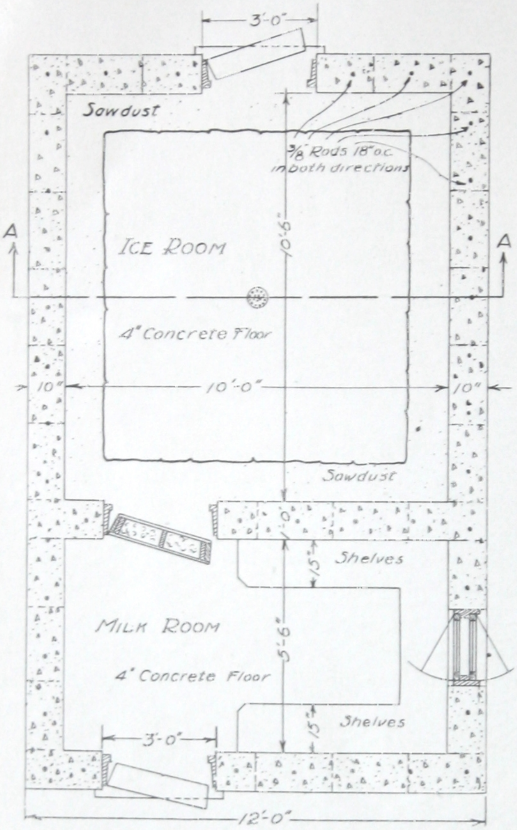
Sectional view of poultry house

Poultry house walls should be of a 1:2½:4 mixture, in which the coarse aggregate consists of material well graded from ¼ up to 1 inch maximum size, on account of the thin wall section. See the chapter on "Forms and Reinforcement." The poultry house design here shown calls for only a 4-inch wall. Carefully constructed, this will sustain the weight well. Nevertheless, in general practice it would be better to provide for a 6-inch wall.

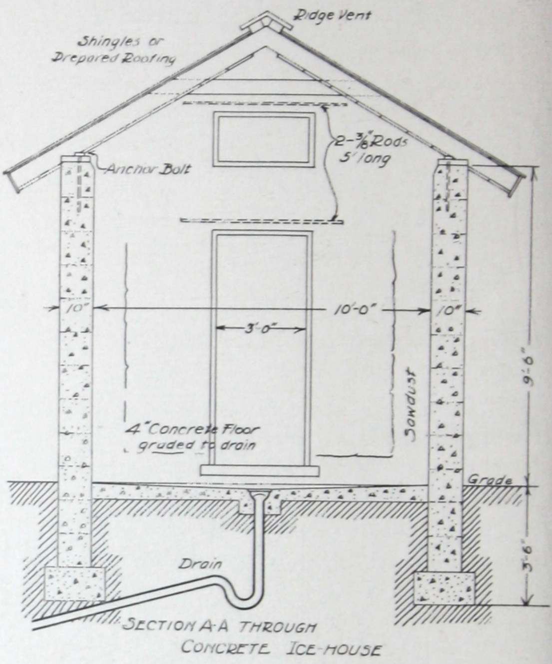
If the walls are of hollow cement block the thickness will be 8 inches, the narrowest practical width for hollow bearing walls.



Floor plan of well arranged cement poultry house



Plan for cement ice house with milk room



Sectional sketch of ice house

Cement Icehouses

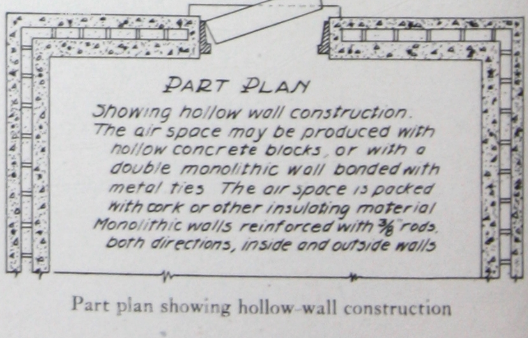
To the average farmer, an icehouse is convenient and profitable. To the dairy farmer it is an absolute necessity. Idle days during the winter, put to harvesting and storing ice, bring the cost of ice very low.

Strange as it may seem, there is a fire-risk involved in the storage of ice. Sawdust or hay or straw is used for packing and probably the variable content of moisture in these materials causes decomposition and consequent heating in a way similar to the heating in the decomposition of manure, and this frequently results in fire.

Wood is a poor material from the economic standpoint to use in icehouse construction. It is not fire-safe and soon rots out owing to the alternate wet and dry conditions to which exposed when the house is filled with ice, and from neglect when empty. No other material is so well adapted to icehouse construction as cement.

The accompanying drawings illustrate a convenient structure which may be built by either of two methods—first, with walls of hollow cement block and second, with double monolithic walls, either method providing an air space which will reduce to a minimum the melting of ice from outside temperature influences.

A number of modifications of the plan will suggest themselves to fit possible individual requirements. For instance, it is quite a simple matter to extend a cement constructed refrigerator compartment into the ice storage room so that this compartment will always be surrounded with ice and



Part plan showing hollow-wall construction

hence serve as an actual cold room for eggs, dressed poultry, milk and cream.

The floor of cement construction slopes in all directions toward a central drain. This floor is made independent of the side walls and should be so laid that there will be a ½-inch joint all around which can be sealed against leakage and entrance of air, by pouring into it hot tar or asphalt. The drain is "trapped" so that the water from ice melting will seal it against the possible entrance of air, thus preventing rapid melting of ice.

The smallest practical dimensions for the farm icehouse should be considered as 10 x 10 x 10 feet, giving contents of 1000 cubic feet. Since a cubic foot of ice weighs about 57 pounds, such a house would hold about 20 tons allowing for the usual waste of space in packing ice.

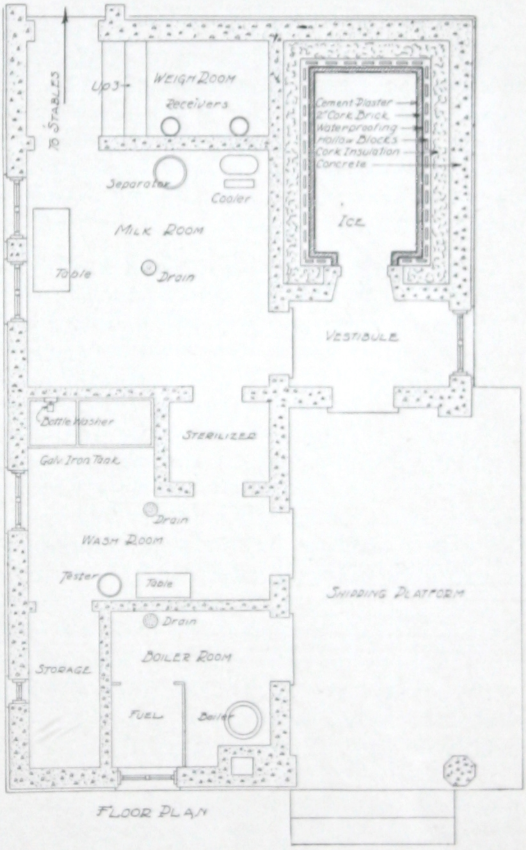
An icehouse should be located in a place convenient to the dairy barn, and on dry, well-drained ground. Building below the ground makes drainage difficult and removal of ice to the ground level equally difficult. It is generally more costly too, for an underground ice house requires the same material and expense in building as one above ground in addition to the cost of greater excavation. The soil is a good conductor of heat. During a large part of the year, ice will melt less in a surface storage room exposed to actual contact with air than in underground storage.

Although the accompanying plans show a wood frame and shingle roof, a cement roof is by all means preferable. This also must be built so as to provide insulation which is accomplished by constructing, independent of each other, two sets of slabs suitably reinforced and separated from each other by a layer of clean, coarse cinders. There is true economy in the cement roof since it is permanent, and in connection with the remainder of the construction, accomplishes complete fireproofness.

> *Send for "Plans for Concrete Farm Building"—28 complete plans—free. Address, Portland Cement Association, 111 West Washington Street, Chicago.*

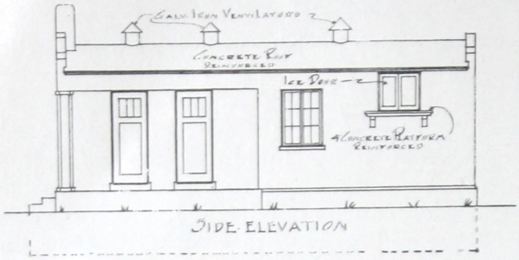
Cement Milkhouses

Many city health authorities having the power to regulate the conditions under which the city milk supply is produced, require that cement construction be used throughout dairy buildings on the farms furnishing milk, so as to make certain that sanitation can be maintained. Such regulations are enforced by State authorities as well.



Cement milkhouse

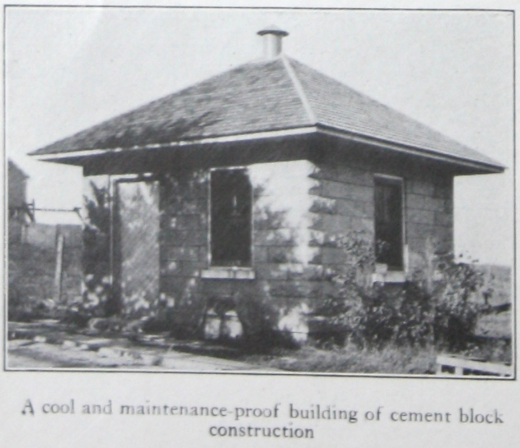
Accompanying designs show a very convenient layout for the dairy-farm milkhouse. Even the shipping platform is of cement construction, so that everything about the structure is permanent. Fireproofness also is secured, which is quite necessary since the boiler room is a part of the building. The method of securing insulation for the ice compartment is shown in detail. Otherwise its construction is not unlike that described elsewhere for a small icehouse.



Cement milkhouse

In this design the shipping platform is specified as 4-inch reinforced concrete. It would perhaps be better if this were made 6 inches thick as it would then be easier to place reinforcing and make certain that it was everywhere surrounded by and perfectly bonded with the concrete.

Although a good interior wall finish can be obtained by mixing the concrete to correct consistency and carefully spading when placing in the forms, it is always desirable to have an exceptionally smooth wall in a milk room so that the surface can be kept thoroughly clean, and it would be well after removing forms to rub down the concrete to the desired smoothness by using a carborundum stone or some similar abrasive, and when the concrete has become thoroughly dry to give the wall several coats of white enamel paint of a kind prepared especially for use on cement surfaces. This will seal any pores on the surface and will be an incentive to greater cleanliness, since any dirt that may lodge on the white surface can readily be seen.



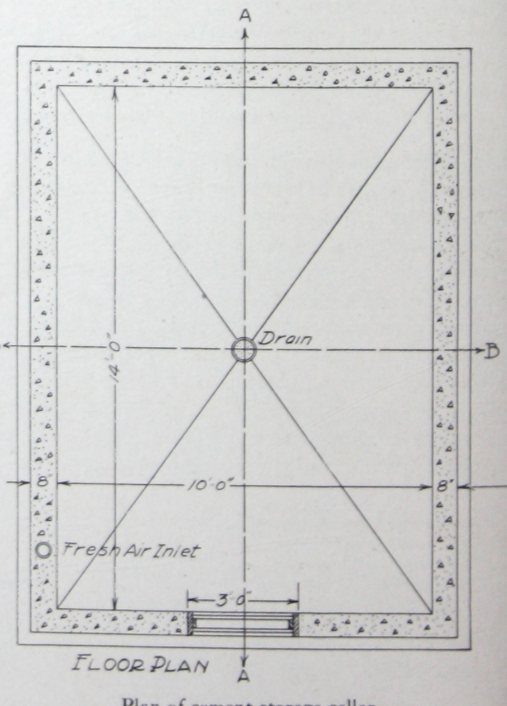
A cool and maintenance-proof building of cement block construction

Root or Vegetable Storage Cellars

Accompanying sketches show in plan and longitudinal and cross-section a cement fruit or vegetable cement storage cellar 10 by 14 feet. A structure of this kind should preferably be located in a hillside or at one side of a knoll, and if so located the necessary excavating will provide sufficient earth to bank the structure and cover the roof, which although not essential, is desirable to assist in maintaining an even temperature inside the cellar.

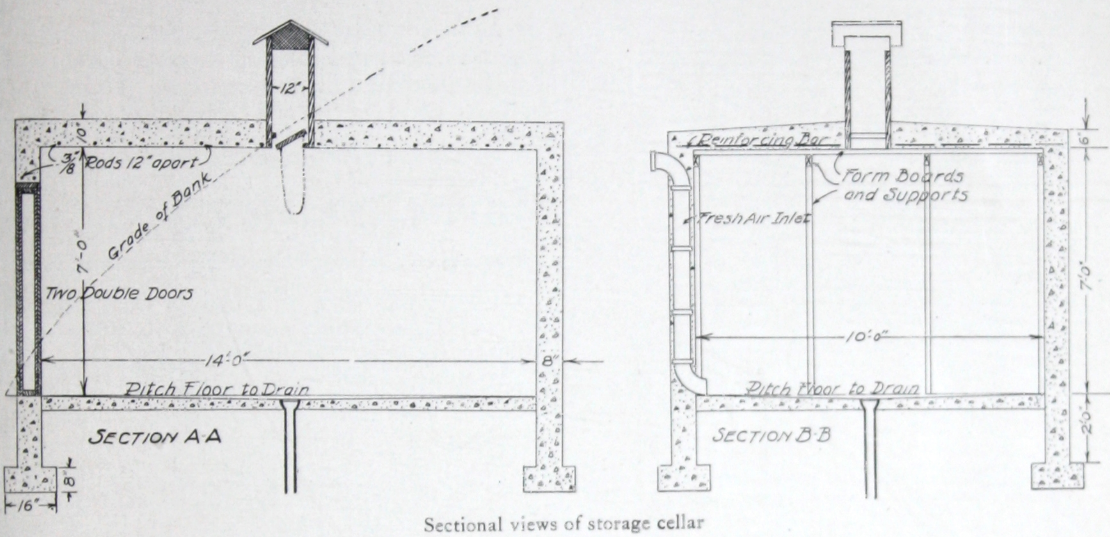
Although not shown on the plans, a structure of this kind should have reinforcing in walls, especially when set into the side of a hill or a knoll, to prevent earth pressure from cracking the walls. For a structure of this size ⅜-inch rods, spaced 18 inches center to center, will probably be sufficient. The sketches illustrate a system of ventilation, which is quite essential in such storage cellars to prevent dampness which would not be best for stored fruits and vegetables.

Ventilator pipes are of 6-inch cement tile. The vents should be covered with galvanized wire mesh to exclude rats and mice. It is a good idea to lay a raised plank



Plan of cement storage cellar

ALPHA CEMENT — HOW TO USE IT



Sectional views of storage cellar

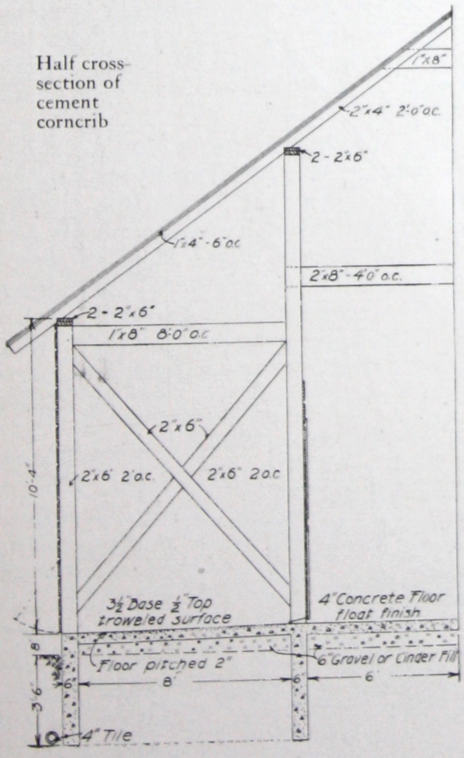
floor over the cement one and to divide the cellar into bins with 2-inch plank partitions, nailing planks ¼ inch apart on 2 by 4 studs so that there will be ventilation all around the stored contents.

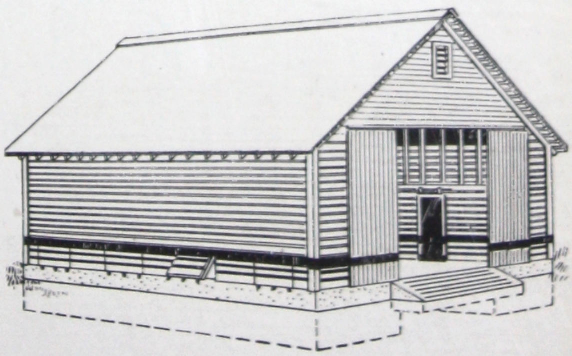
Ratproof Corncribs

Accompanying designs show a corncrib designed by the United States Department of Agriculture, in which ratproofness is secured by cement foundation walls and floor and a fender strip that prevents the rats from climbing up side walls. The crib is a double one, each compartment having an estimated capacity of 1,000 bushels of ear corn. The driveway as well as the floors in the cribs proper are paved or floored with cement. Construction of such floors has already been described under the heading "Walks and Floors." In setting up forms for the cement floor in the cribs the form boards should be set so that the floor will have a slope of at least ¼ inch to the foot. This slope should, of course be toward the outside.

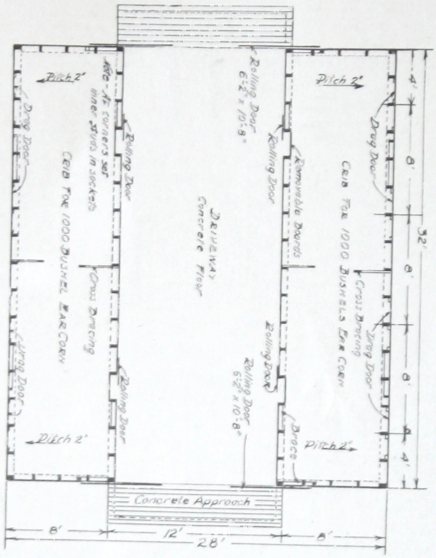
It is also possible to build corncribs of cement throughout, using cement corncrib blocks having openings extending through them and slanting downward to prevent the entrance of rain.

Half cross-section of cement corncrib





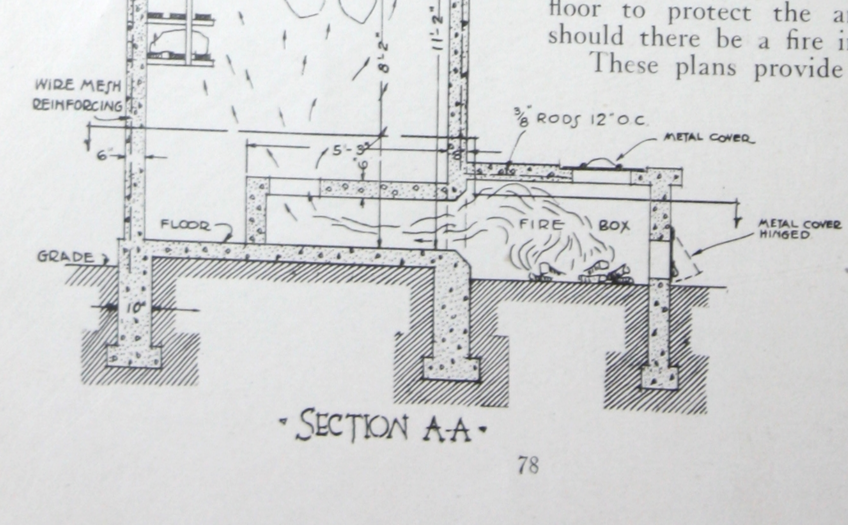
Good type of corncrib



Plan of cement corncrib

Cement Smoke House

Suggested plan for a reinforced cement smoke house with fire-box placed outside of the building is shown in the accompanying sketch. The fire-box is so designed that in joining the smoke room there is a down draught, thus preventing the fire from burning too freely, and causing it to smoulder and smoke instead. Such a structure should be at least thirty days old before put to use.



Barns, Stables, Silos, etc.

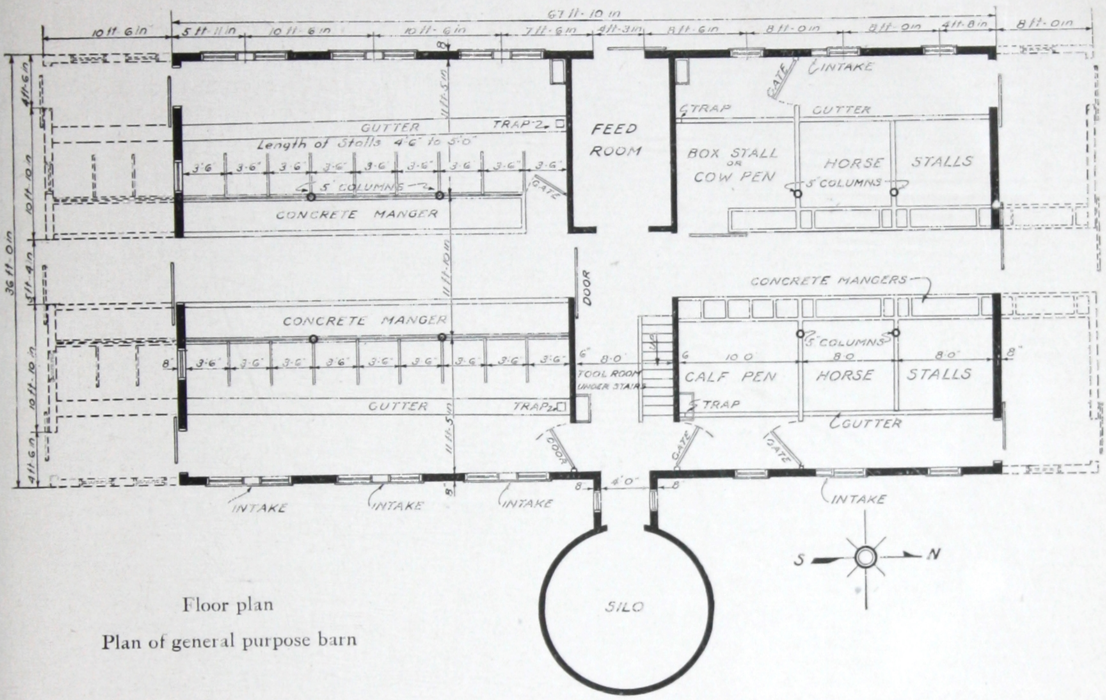
The advantages of a barn of cement construction are made apparent by what has already been said elsewhere about first cost, maintenance cost, proof against fire, vermin, weather and other deteriorating influences.

Barns may be built of block or monolithic cement construction. The foundation walls should be 12 inches thick, following in construction the suggestions made in the data on Foundations, on pages 40 and 62. Walls above ground for two-story barns should be not less than 10 inches thick.

Floors should be built with care, as suggested elsewhere in this book. They should be 5 or 6 inches thick for one-course construction. Where animals walk or stand, the surface should be finished with a wood float to give an even but non-slipping surface. Over-troweling often causes checking. Barn floors should be laid in slabs not larger than 10 feet in any one dimension with joints extending clear through the floor, to prevent unequal settlement or cracks caused by expansion.

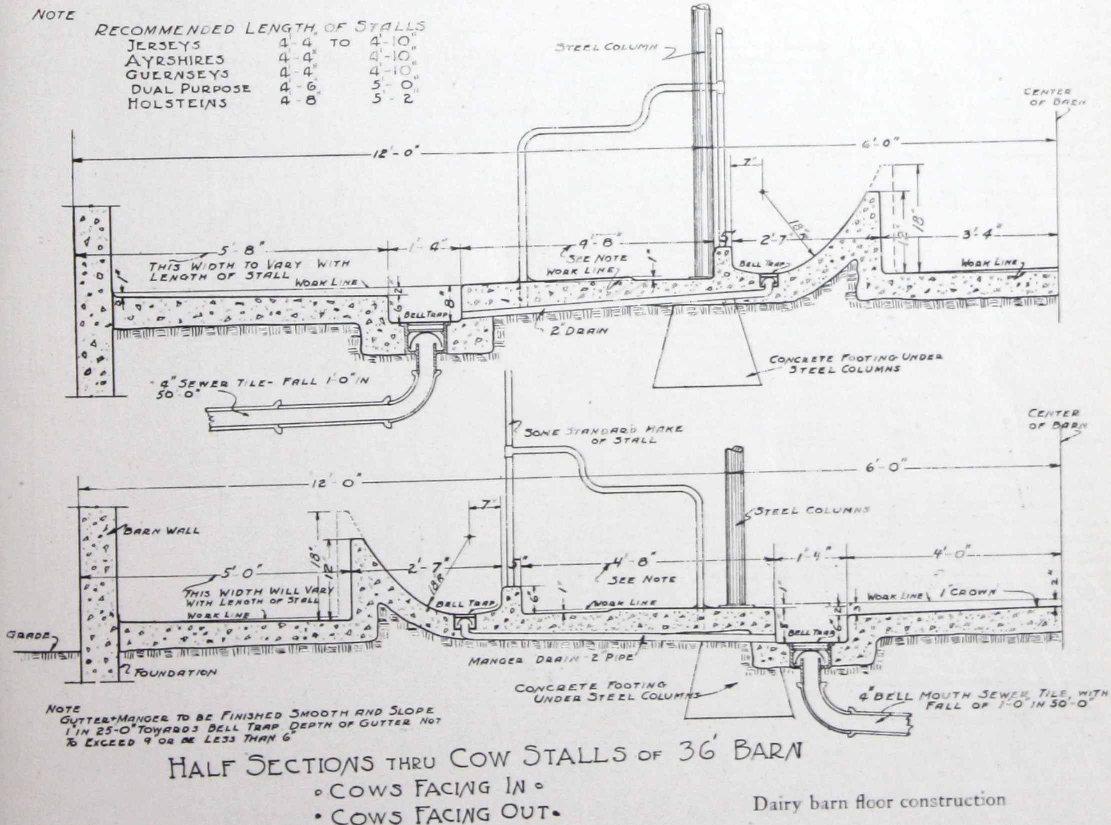
The accompanying sketches show a good design for a general purpose barn. The arrangement of horse stalls excludes odors from the dairy barn proper, from the feed room and other dairy apartments. The second story has a fireproof cement floor to protect the animals underneath should there be a fire in the hay storage.

These plans provide good facilities for indoor lighting. The United States Department of Agriculture recommends 6 square feet of opening for each animal and gives 4 square feet as an absolute minimum. Figure on ample room for the animals.



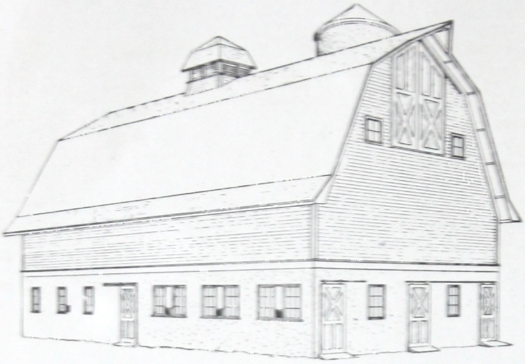
Floor plan

Plan of general purpose barn



Dairy barn floor construction

ALPHA CEMENT — HOW TO USE IT



Perspective View of General Purpose Barn

Cement Stable or Barn Floors

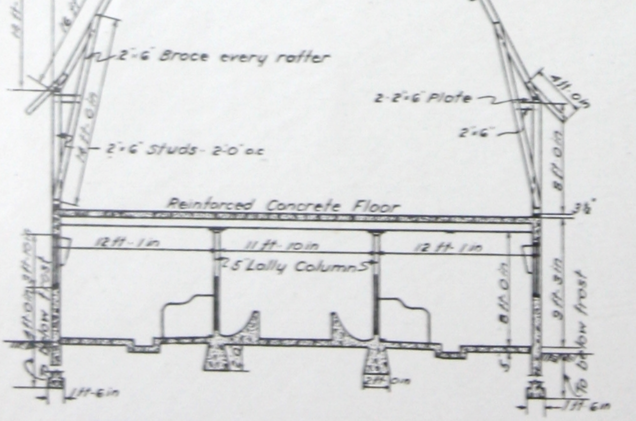
All refuse and soft earth is removed from within the barn and the floor laid out, excavating or filling in as necessary to bring the subgrade to the required level. All portions of the subgrade must be thoroughly tamped to insure a sound base for the concrete.

Recommended dimensions are secured by reference to the cross-sectional illustration shown on the preceding page, approved by the American Society of Agricultural Engineers.

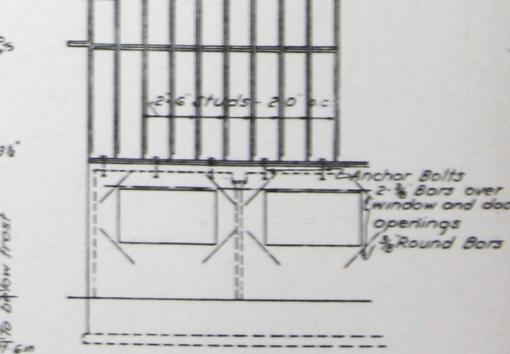
It is usually considered easier to proceed by placing the manger curb first. Stanchion supports are carefully placed to secure perfect alignment and anchorage. The greatest care must be exercised in getting the proper level for this curb, then carefully taking levels from it for other parts of the work. Steel stall partitions are next erected, after which stall floor, gutter, manger and alleys are completed, usually in order mentioned. Most manufacturers of stall equipment furnish patterns or templates with directions for use in with their particular appliances.

All portions of the work except the curbs, mangers and gutters must be finished with a wooden trowel, securing the desired grade and a surface smooth enough to be sanitary and easily cleaned, yet sufficiently rough to prevent the animals from slipping. Round interior and exterior corners to make cleaning easy and to afford more comfortable surfaces for the animals.

The entire thickness of the floor, manger, gutter, etc., are conveniently placed in one operation or as "one course work" for a 1:2:3 mixture is recommended, having a jelly-like consistency. In finishing the surface, a small amount of 1:2 mortar may be added if necessary to secure sufficient smoothness. Gutters and mangers should be sloped at the rate of ¼ inch to the foot toward drain outlets.



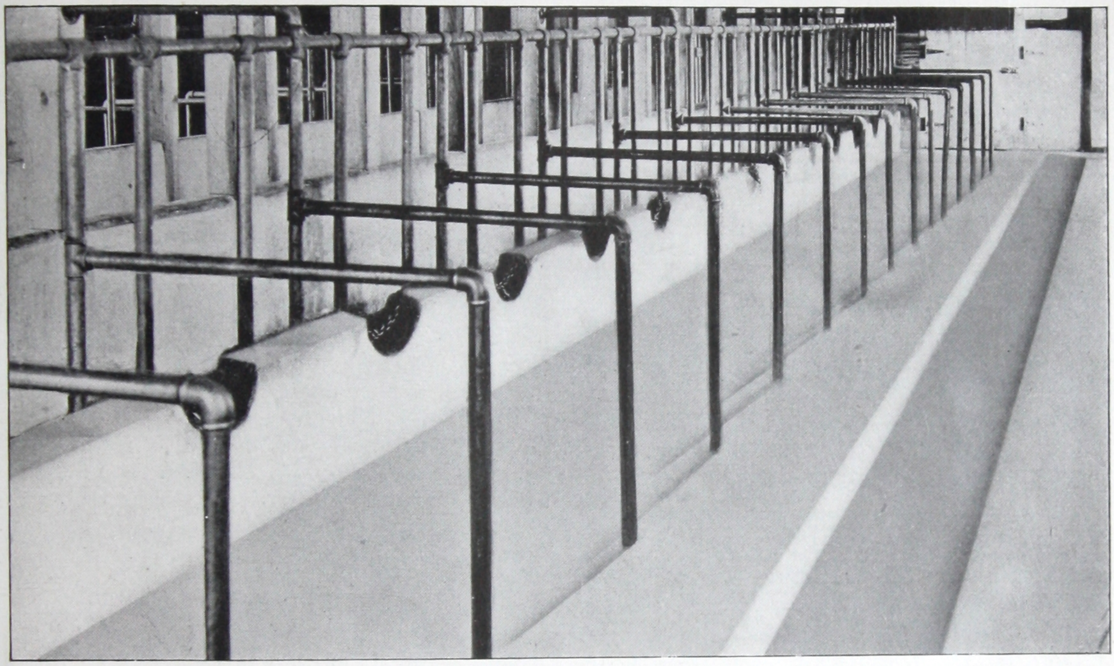
CROSS-SECTION THRU COW STALLS



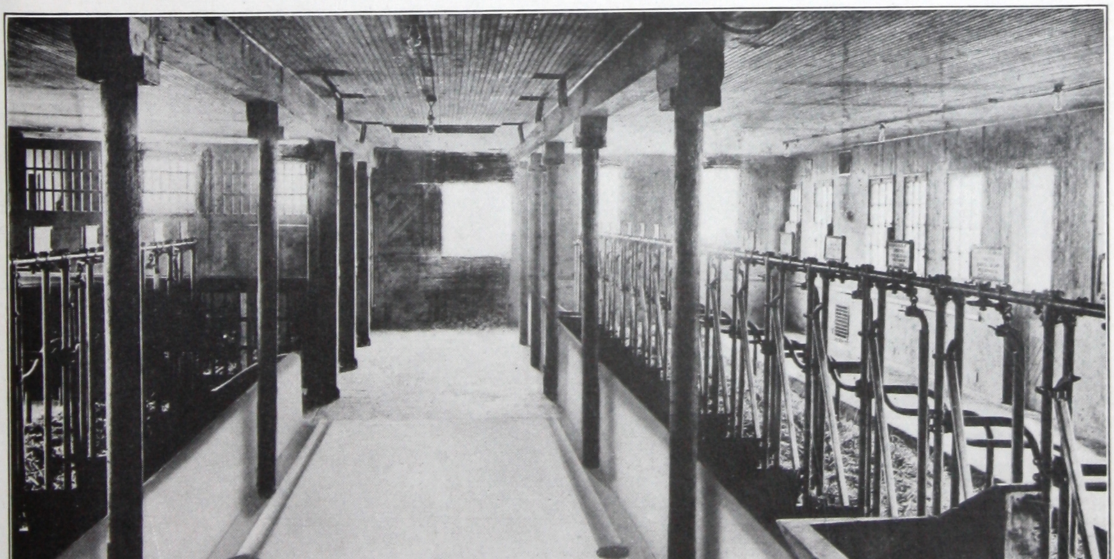
SIDE FRAMING

Sectional View of General Purpose Barn

ALPHA CEMENT — HOW TO USE IT



View in a model dairy where cement replaced wooden floors



Model dairy barn, showing cement feeding alley between rows of stanchions

Caring for Cattle and Floor. Regardless of the kind of floor, bedding of straw or litter is an absolute necessity; it keeps the cow clean and absorbs the valuable liquid manure. If the help cannot be depended on to bed the cows properly, it is advisable to use a removable wooden grating or platform. Cork bricks, set two inches in the cement, are often used.

Feeding Floors

When feed was thrown out on the old-fashioned feeding lot, part of it was eaten and part trampled into the mud—wasted. Wood feeding floors were no improvement. They harbored rats and often became so unsanitary as to menace the health of the herd.

Cement feeding floors which overcame all of these things, have been said by conservative men to be able to pay for themselves in a year.

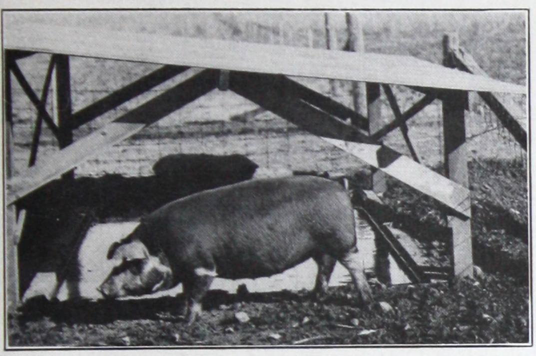
Details of construction are similar to those described elsewhere under "Walks and Floors." The location should be one where drainage is good and if possible where the animals to be fed will be afforded protection from wind. The site should be cleaned of all vegetation, and any soft spots dug out and refilled with gravel containing only a small amount of sand or with clean cinders free from ashes, and well compacted. The floor should be sloped toward one side where there should be a gutter that is connected to a tile line leading to a manure pit so that all of the animal droppings on the floor can be preserved.

Feeding floors should be made preferably not less than 5 inches thick and of one-course construction, being laid in slabs no greater than 6 feet in one dimension (36 square feet in area). In finishing, one should use a wooden float instead of a steel trowel. The wood float finish largely does away with the possibility of hair cracking and leaves a gritty texture to the pavement surface that provides a good foothold. A cement feeding floor should be washed off occasionally with broom and water, and in case of stock disease, and the necessity for thorough disinfection the surface may be sprayed with gasoline and the gasoline set afire, thus destroying all disease germs.

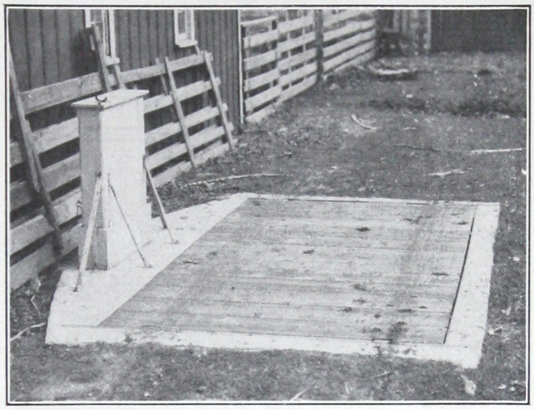
A feeding floor should always be built with a curb around it extending two or three inches above the floor level to prevent the animals from shoving feed off the floor when eating. This curb should also extend a foot or eighteen inches below the bottom of the floor to prevent rooting under it.

Cement feeding floors save grain, labor and fertility. They quickly pay for themselves

ALPHA CEMENT — HOW TO USE IT



Cement increases hog comfort; prevents disease



A frame that will stand hard use

Cement Hog Wallows are Profitable

Hogs will keep clean if given a chance and it is certainly to the interest of every hog raiser to protect the health of his animals by putting in a cement wallow. In this way disease is avoided and the hogs gain faster because they are more comfortable. Hogs have a strong instinct to cool themselves by bathing, and unless a clean place is provided they are sure to pick out a damp or wet spot in the mud, fashioning it into a wallow which soon develops into a breeding place for disease.

Most cement wallows are made by scooping out the earth into the shape of a shallow bowl, using a board template swinging around a vertical rod set up as a center. When properly excavated and compacted, the concrete is placed exactly as for a floor except for the curvature. The slab should be made 5 inches thick of 1:2:3 concrete, the top being brought to shape by means of the template device, a wooden straightedge and a small wooden trowel. The concrete is reinforced with a thickness of bull fencing or other heavy woven wire material laid midway between bottom and top of the slab.

The maximum depth should be about 18 inches, so that the greatest water depth will be about 15 inches. A circular opening, connected to a tile drainage outlet should be provided for use in draining the tank. This opening should be fitted with a wooden plug. An apron or curb is often placed around the wallow to prevent rooting under it. Similar construction is used for rectangular wallows which are somewhat more difficult for the amateur, for which reason circular wallows are often preferred.

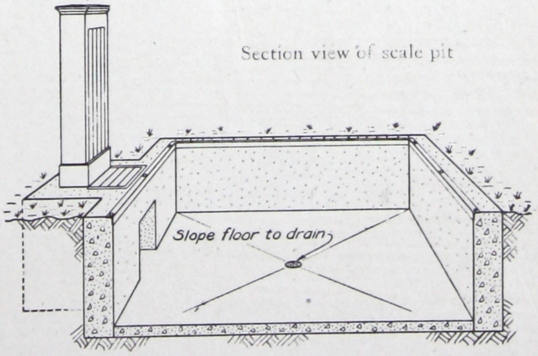
Scale Saves Many Times Its Cost

A platform scale securely and permanently installed in a cement pit will weigh accurately and require no attention or outlay for repairs. Used to weigh supplies purchased as well as produce and animals shipped, it prevents losses and arguments. Without a good scale the farmer must depend upon the other fellow's honesty and accuracy.

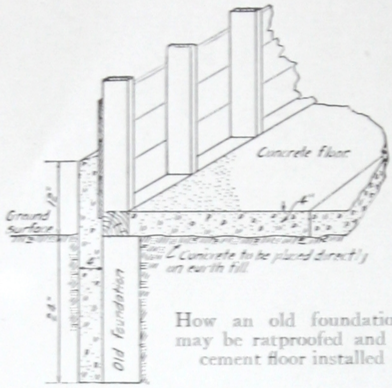
Construction of the pit is very simple. A high, well drained site is selected if possible and a foundation wall of monolithic concrete is placed as shown in the sketch, according to dimensions furnished by the scale manufacturer. To protect the inner edge of the surface, 1½-inch angle iron strips are set in, being anchored to the concrete by means of bolts embedded at intervals of three feet.

A tile drain is placed with drain trap in the center of the floor, sloping the floor to it. The tile must be carried to a suitable outlet. The floor is laid according to general directions contained on page 64.

Section view of scale pit



ALPHA CEMENT — HOW TO USE IT



How an old foundation may be ratproofed and a cement floor installed

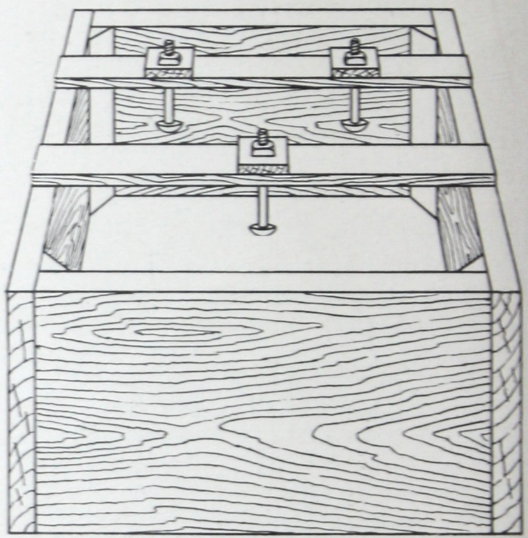
Ratproofing Frame Structures

If farm buildings are built of cement construction rat problems quickly disappear; if the structures are of frame, concrete will effectually ratproof them. The upper illustration shows the method by which wooden foundations are ratproofed by the use of a "false" wall of concrete 4 inches thick, extending 24 inches below grade and 12 inches above grade. If more convenient, the false wall may be placed inside the foundation.

The lower illustration shows an effective method of building out rats and mice in the case of buildings supported on posts or piers. Where this construction has been used, the building should be raised if necessary, until the distance from ground to floor joist line is at least 18 inches. The mixture should be just wet enough to flow into place. If there is room the concrete may be tamped to make sure that the space is completely filled.

Cement Engine Bases

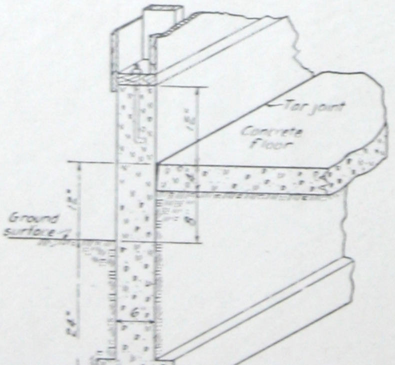
Cement is the only really acceptable material for stationary engine bases. Vibration is absorbed and the engine kept plumb and in perfect alignment, factors which lengthen its life and reduce noise to the minimum. Engine bases are usually simply



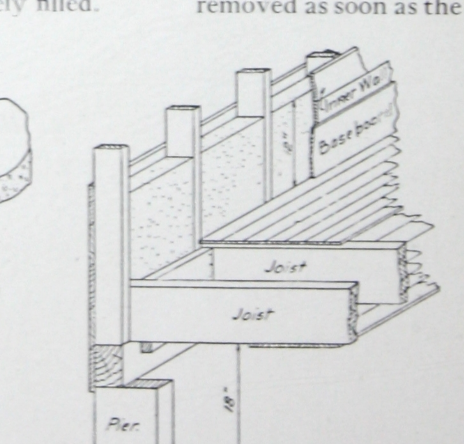
Form for cement engine base

rectangular blocks of concrete in which are embedded the necessary bolts for attaching the engine frame. Simple box forms, like that shown, are all that is required for the making of small bases, the template boards across the top being used to assure proper location of the engine bolts. The forms are carefully removed as soon as the block is strong enough to permit, and the surface troweled after which it may be coated with a creamy mixture of cement and water.

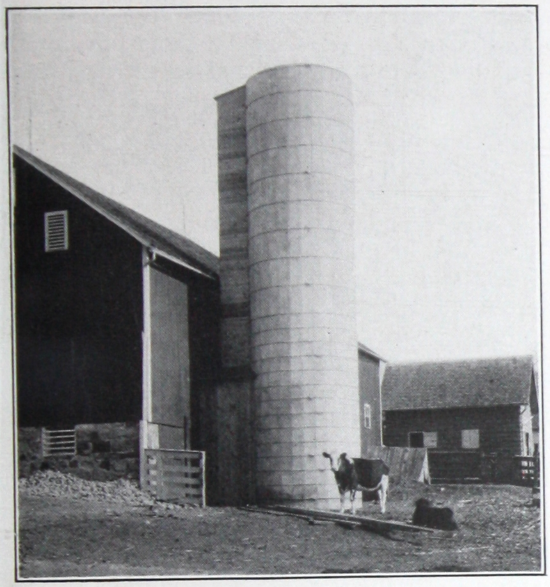
For engine and pump bases 1:2½:5 concrete is ordinarily employed, using particles as large as 2 inches in diameter and mixing with just enough water to give the mass a "quaky" or "jelly-like" consistency. Surfaces are carefully spaced, the top lightly tamped.



Showing a good method of making foundation and floor of a new building ratproof



Buildings supported on piers are ratproofed by raising above ground level and placing concrete between walls above sills



Thousands of cement stave silos are profitably employed by dairymen

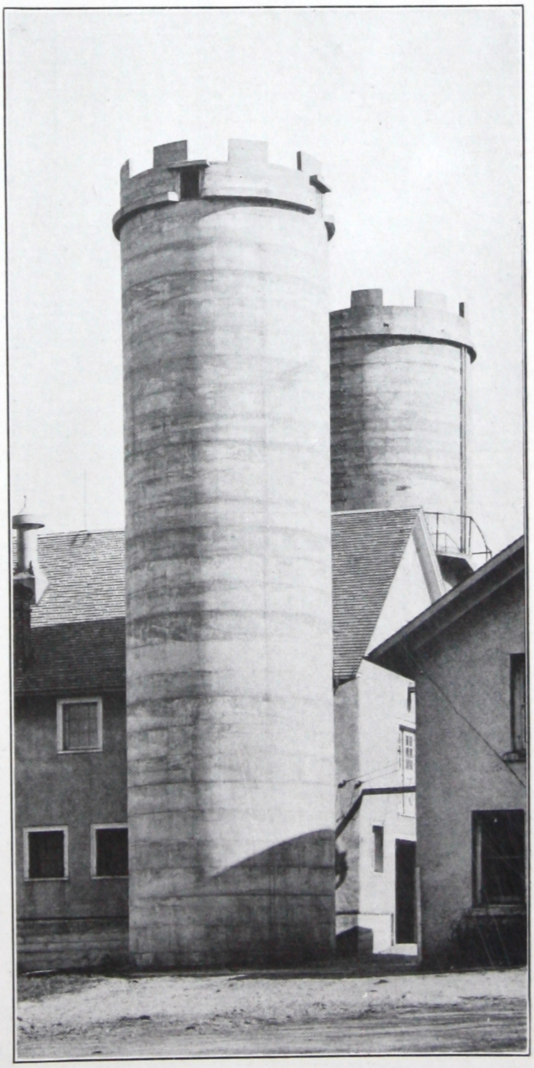
Cement Silos

Even for the smaller dairyman or stock-raiser, a good silo will provide both profits and feed insurance. The silo not only produces more and better feed from a given acreage at less labor and expense, but it removes much of the risk by safely storing succulent fodder from one fresh-feed season to the next. Silos very often pay back their entire first cost in one filling and may be depended on to do so in two or three fillings. The permanent, maintenance-free cement silo then remains a constant source of profit without any outlay whatever.

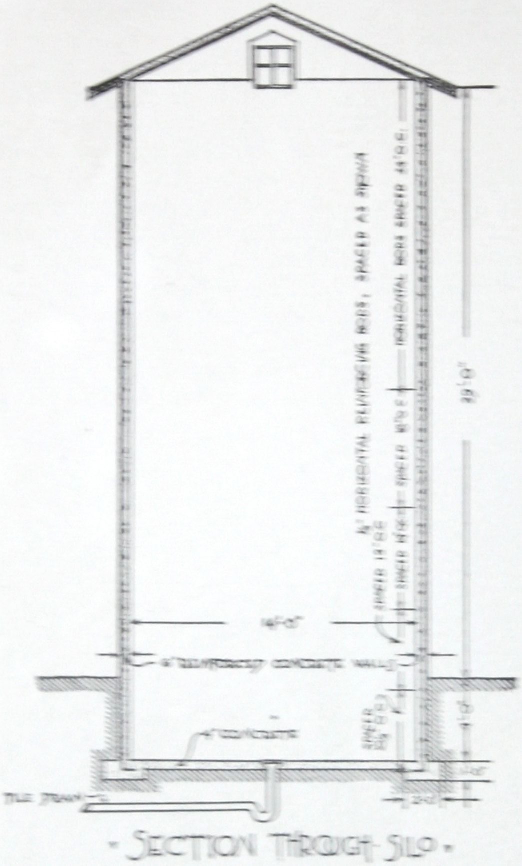
Cement silos are fireproof and therefore not at the mercy of barn or stack fires; when properly packed they are air-tight, keeping silage with minimum spoilage. Losses from rats are unknown. Cement silos are not attacked by rot and they stand secure whether full or empty. Three types of cement silos are all giving excellent satisfaction—whether built monolithic, of cement blocks or of cement staves.

Where convenient it is desirable to have a competent contractor build the silo. The cement stave silo has become immensely popular during recent years and contractors in nearly all parts of the country specialize in manufacturing and erecting them. This type is an assembly of small cement slabs, usually 30 inches long, 10 or 12 inches wide and 2½ inches thick, so formed that they interlock or fit together tongue-and-groove fashion. The silo rests on a heavy cement footing, similar to those prescribed for monolithic silos. The staves have opposite sides exactly parallel, so that when tightly held in position by steel hoops they fit so closely as to produce an air-tight and water-tight tank. They are coated on the inside with a flint-like cement paint or enamel which acts as a further seal and produces a smooth surface to which silage will not cling.

Cement block and monolithic silos are built largely by contractors, although a



These handsome monolithic cement silos adorn as well as serve a prosperous mid-western dairy farm



Cross-section of monolithic silo

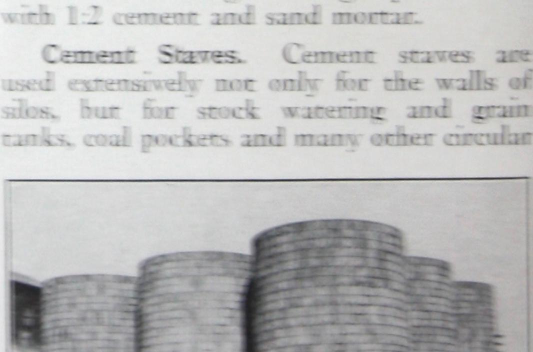
great many farmers have built their own silos of Alpha cement. Regular silo contractors are prepared to do much better work, however, and experience has shown that their prices average very little more than for home made silos, figuring owner's time at a fair rate. Farmers who select the monolithic type of silo may do so with the assurance that although slower to build and requiring more material, it is without question the most substantial structure obtainable, and is especially recommended as a pedestal for water supply tanks, the great weight of which makes it inadvisable to place them on silos of other types.

The Alpha service department will gladly supply service sheets containing complete information for the farmer who desires a monolithic silo. These show how to build substantial forms, handle the reinforcing, construct the roof and care for other details of the work in proper manner. "Concrete Silos—Monolithic and Block" by the Portland Cement Association contains much valuable detail information which may also be had free on request.

Monolithic Silo Pointers. In order to be air-tight and water-tight, the concrete for the walls must be of jelly-like consistency carefully spaded next to the forms; provision must be made so that doors will fit perfectly and a tight roof and chute should be provided, without ventilators. Medium wet concrete will insure dense smooth wall surfaces which not only keep out air and water, but they allow silage to slip down easily, thus avoiding air pockets. The weight of a cement silo requires that the footings be made a full 2 feet in width, resting on firm soil, below frost penetration. Four feet is a good depth for the silo tank. The reinforcing must be as specified in Alpha service sheets, and accurately spaced in the center of the wall. In leaving off and resuming work the practice suggested in the chapter on "Making Concrete Watertight" should be adhered to.

About Cement Block Silos. The block used for cement block silos are usually of the hollow variety, made on the circumference to correspond with silo diameters of 12, 14, 16 and 18 feet. The footing is made as for a monolithic silo, starting the first course of block directly upon it. In order to obtain a neat and efficient job the block should be laid by a first class mason. The interior surface is given a light plaster coat with 1:2 cement and sand mortar.

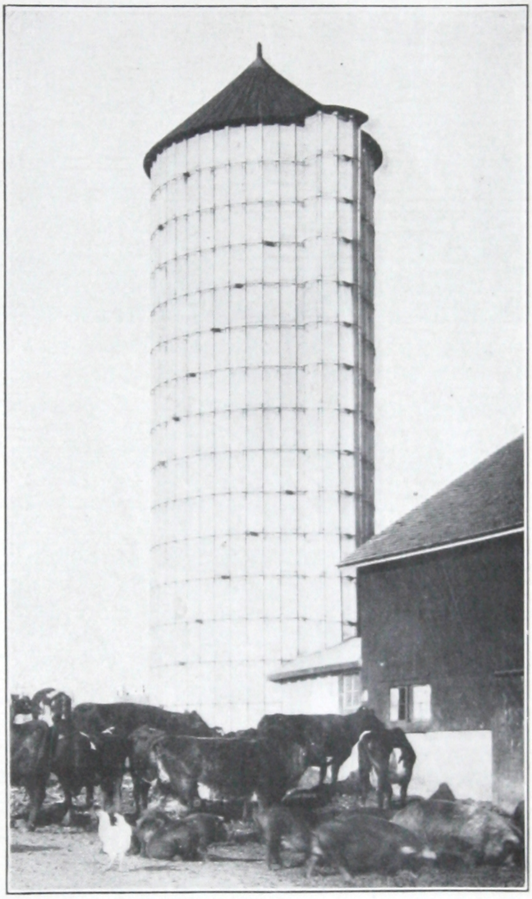
Cement Staves. Cement staves are used extensively not only for the walls of silos, but for stock watering and grain tanks, coal pockets and many other circular



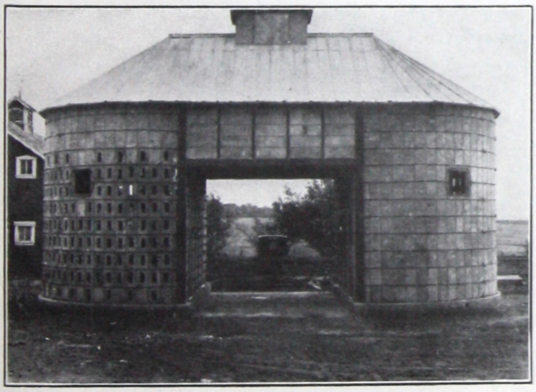
A battery of cement stave silos used for storing and handling coal

farm structures as well. There are also many rectangular structures such as barns, poultry and hog houses and corn cribs built of these units. Such work is always done by experienced cement stave contractors and invariably proves very economical when compared with the cost of less enduring types.

Capacity of Silos. The size to build depends upon the number of animals to be fed daily and the quantity of silage in pounds required for each animal, as well as the number of days it may be necessary to feed them. Dimensions of a silo should be fixed in accordance with the size of the herd so that a day's feeding will represent the use of not less than 2 inches of silage. This will prevent the molding of a thin top layer. The ordinary dairy cow requires about 40 pounds of silage per day, and the table below gives suggestions as to the dimensions of silo to build for herds of various sizes and to provide for different terms of feeding based on the 40-pound daily ration.



The "chutes" of cement silos, as well as the main walls, are frequently of fire-proof cement staves

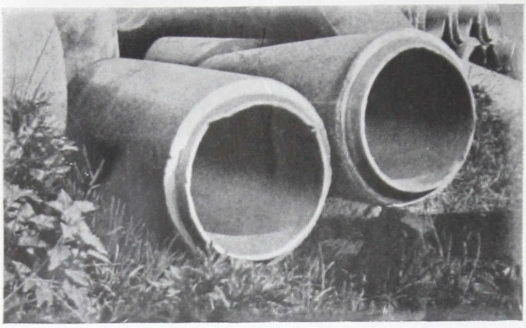


A cement stave granary, one side accommodating ear corn, the other small grains

Fine appearance, elimination of paint, rust, rot and repair go along with permanence in cement construction.

DIMENSIONS OF SILO ACCORDING TO SIZE OF HERD

Number of Cows in Herd	Feed for 180 Days				Feed for 240 Days			
	Estimated Tonnage of Silage Consumed	Diameter of Silo	Height of Silo	Corn Acreage Required at 15 Tons to Acre	Estimated Tonnage of Silage Consumed	Diameter of Silo	Height of Silo	Corn Acreage Required at 15 Tons to Acre
	Tons	Feet	Feet	Acres	Tons	Feet	Feet	Acres
10	36	10	25	2½	48	10	31	3½
12	43	10	28	3	57	10	35	4
15	54	11	29	4	72	11	36	5
20	72	12	32	5	96	12	39	6½
25	90	13	33	6	120	13	40	8
30	108	14	34	7½	144	15	37	10
35	126	15	34	8½	168	16	38	11
40	144	16	35	10	192	17	39	13
45	162	16	37	11	216	18	39	14½
50	180	17	37	12	240	19	39	16
60	216	18	39	14½	288	20	40	19
70	252	19	40	17	336	..	..	..



Cement pipe in fine condition after a generation of use

Cement Well Platform

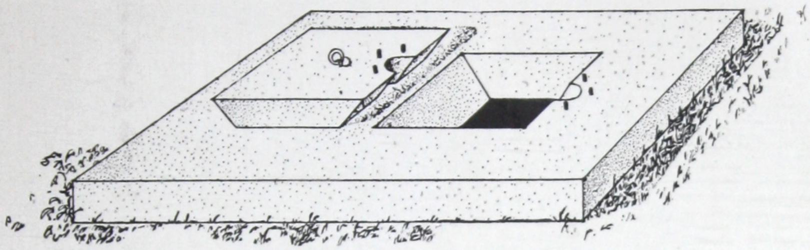
There are several methods of building a cement well platform. The choice is dependent on the manner in which the pump barrel and stock are joined together. In the illustration is shown a platform 5 inches thick and 5 feet square, which contains a manhole fitted with a cement lid. The pump stock passes through the platform by means of a circular hole at the side and a part of the manhole opening. By this means the pump stock and barrel can be joined together and slipped into position by a person working through the manhole. Afterwards the cement manhole lid is set in place. Moreover, this lid is heavy enough that it cannot be removed by a child.

In preparing the well for a cement platform, see that 4 or 5 feet of the curbing near the top of the well is of solid concrete, or of blocks or bricks laid up with cement mortar mixed in the proportion of 1 part cement to 1½ parts sand. Carry the curbing 6 or 8 inches above natural ground level and grade the turf to this height so that surface water will flow away from the well. Prepare to mold the cover on a wooden platform of 2-inch boards laid over the well or placed on a level spot of ground. For most wells, a platform 5 feet square by 4 inches thick is sufficiently strong. To provide for a manhole opening, build a bottomless box, of 1 by 6-inch boards, 5 inches deep, 2 feet square at the top and 18 inches square at the bottom—outside measurements. Another plan is to have a tinsmith make a round bottomless tin form 5 inches deep, 2 feet in diameter at the top and 18 inches at the bottom, after the pattern of a large bottomless dish-pan. To either manhole form attach a wooden block of the size and shape of the pump barrel or stock. Grease the manhole frame and set it on the wooden platform where the opening in the well cover is desired.

Have the concrete just wet enough to flush a little cement mortar when tamped into place. Over the entire wooden platform, except within the manhole frame, spread 1 inch of concrete. For reinforcing, immediately place on this concrete 5-foot lengths of ⅜-inch iron rods running in both directions (criss-cross) and spaced 9 inches apart. Bend the ends to a hook-shape. Strengthen the platform around the manhole opening by placing an additional rod on each side. Bring the cover to its full thickness at once by tamping in the remaining 4 inches of concrete.

For fixing the base of an iron pump securely to the finished well platform, place in the soft concrete around the pump opening ordinary bolts (washered and heads down) to the depth of 4 inches. To locate these bolts correctly, set them by means of a wooden block or template in which holes have been bored and spaced exactly like those in the pump base. Lag bolts or similar devices may also be used for this purpose. Finish the surface of the platform with a wooden float, just as would be done in the case of sidewalks. If the greased tin form is used, the manhole cover may be cast at the same time as the rest of the floor. Reinforce the lid with short lengths of iron rods laid criss-cross. As a lifting ring use half of an old bridle bit, or a hitching-post

Sanitary well platform of cement



Cement well platform with manhole cover removed. It settles for all time the problem of keeping mud and unclean water from running down into the drinking supply. Such a platform looks clean and is clean

ring, the end of which is provided with a knob of twisted wire or with a nut and large washer. If the wooden manhole form is used, carefully remove it after four hours. One day later build the manhole lid the same as for the tin form with this exception —place greased paper or cardboard around the edges of the opening to prevent the new concrete from sticking to that of the platform. To make the manhole lid lighter in weight, before placing the concrete, spread 1½ inches of wet sand over the wooden platform inside the manhole opening and then tamp in the concrete. Take care to place the reinforcing within 1 inch of the bottom of the manhole lid.

After the well platform is two weeks old, carefully remove the wooden boards on which it was built and set or lower it into place.

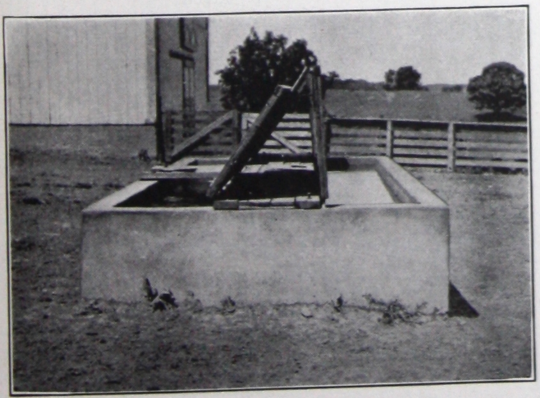
Feeding and Watering Troughs or Tanks

Cement tanks or troughs are more easily kept in sanitary condition than those of any other material and they have a very decided advantage from the standpoint of permanence.

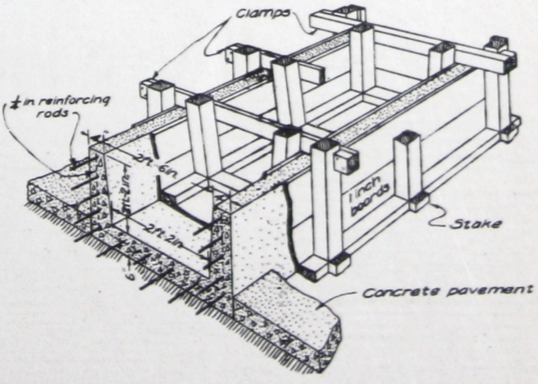
It is of course essential that tanks or troughs which are to hold liquids shall be water-tight; see page 32. It is also necessary where possible to arrange for it, that the work be carried on continuously from start to finish so as to prevent construction seams in the work through which leakage could take place. See the chapter on "Forms and Reinforcement." If concrete is thoroughly spaded in the forms while placing, particularly next to form faces, the resulting surface will be smooth, dense and water-tight and will need but little pointing up after forms have been removed. If a smoother finish is desired the whole structure can be painted with a cement grout paint.

A batter or slope should be given to the inside wall face of troughs and tanks so that in case the contents should freeze the ice will rise, thus relieving the tank from the pressure of expansion; otherwise they are likely to crack.

Small tanks and troughs can readily be cast upside down as shown on page 24, and when the concrete has hardened sufficiently to permit removing the forms they can be protected as suggested elsewhere for



Good type of cement watering trough



Section view of stock watering tank

fresh concrete, and after ten days or two weeks may be carefully moved to the place where they are intended to be put to use.

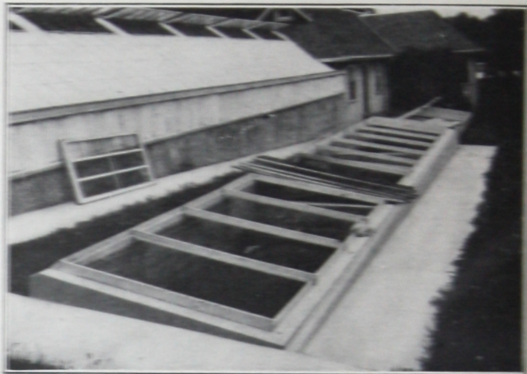
As in many other classes of cement work, the best materials and workmanship will count for little or nothing unless the concrete is properly protected after being placed to prevent too rapid drying out and this is very important in connection with troughs or tanks, which if allowed to dry out rapidly would be porous.

Hotbeds

Most of the wood used in hotbed construction is in contact with the soil and rarely lasts more than two seasons, while if concrete were used such construction would be permanent and the slightly increased first cost would soon be compensated for by doing away with repairs and rebuilding.

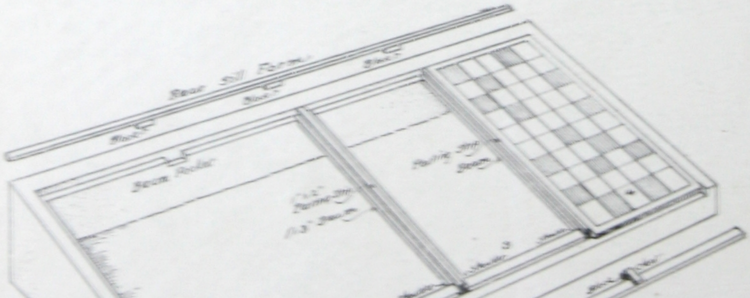
Usually cement hotbeds require only the simplest of form construction, and where the ground is self-sustaining only an inside form will be required for the cement work below ground level. At ground level, both inside and outside forms must be provided for the walls above ground.

The dimensions of the bed should be such that standard storm window sash, six feet long by three feet wide, will exactly fit. Such sash are available almost everywhere at low cost. The sash should be primed and painted in order to preserve them against rapid deterioration from exposure to the weather.



Well located cement hotbed

For hotbed construction a 1:2½:4 concrete will be suitable. Walls should be from 6 to 8 inches thick with two ⅜-inch round rods bent to a right angle at each corner, these rods being 4 feet long and extending 2 feet into end and side walls. When finishing the back wall (which is the higher one) to provide for slope of sash, it is very easy to embed fastenings in the concrete for attaching sash hinges. A very convenient adjunct of the cement hotbed is a 2- or 3-foot cement walk on the low side, so as to make it easy to get around the bed during periods when the ground is wet. This feature considerably increases the ease and comfort of working in and around the bed. No stretch of cement hotbed wall should be longer than 25 feet unless the next section is completely divided from it by a contraction joint, as the expansion and contraction due to temperature changes in a stretch of hotbed wall longer than 25 feet is quite likely to result ultimately in cracks in the wall.

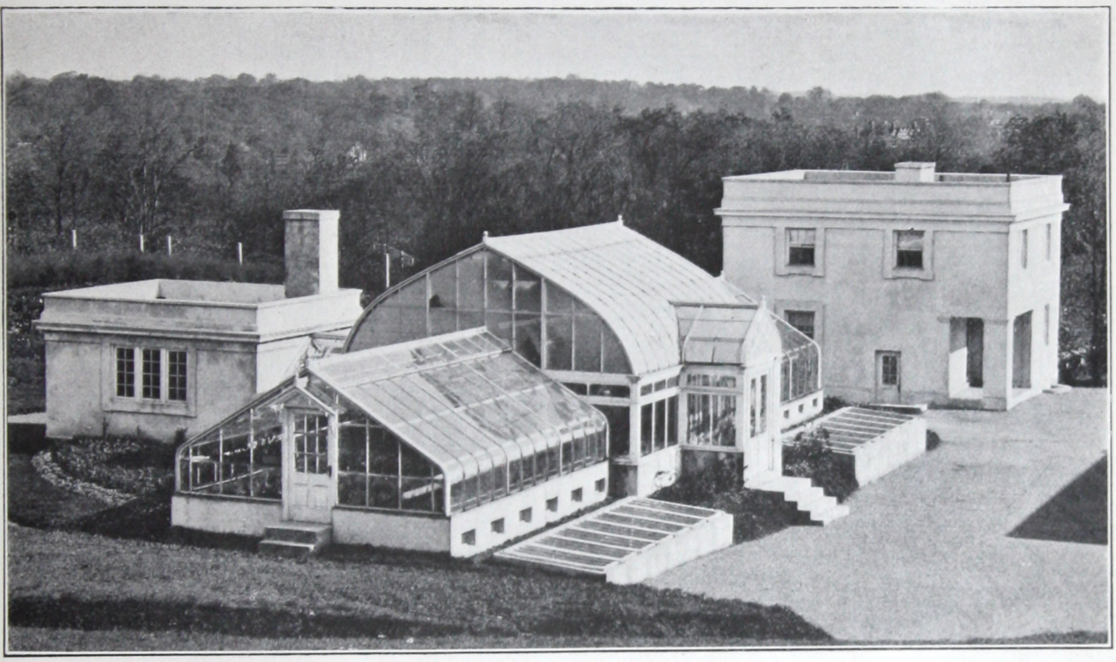


Perspective view of hotbed showing the last sash in place

Greenhouse with Cement Walls, Floors and Benches

In the hot, moist air necessary for cultivating or forcing plants under glass, wood construction soon goes to pieces from rot. This suggests cement for all portions of a greenhouse which need not be of steel frame and glass.

ALPHA CEMENT — HOW TO USE IT

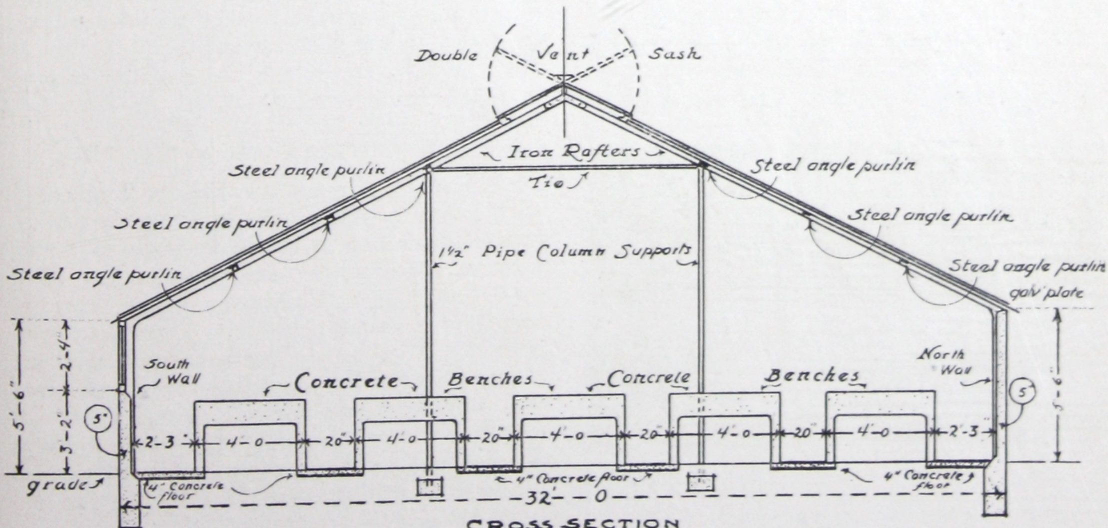


Attractive grouping of gardeners' house, workroom, greenhouses and hotbeds, at Greenwich, Conn. (Lord & Burnham Co., builders, Carpenter & Blair, architects)

Accompanying sketches show in section a greenhouse with cement walls, floors and benches, and detail of the benches or beds.

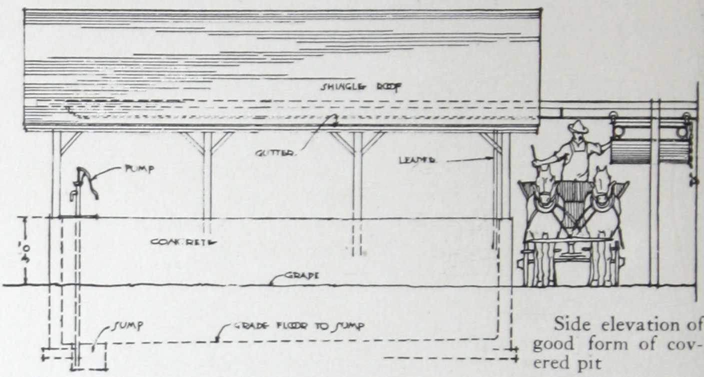
Walls for this structure may be from 8 to 10 inches thick, depending upon the weight of superstructure. Ten inches would be sufficient in extreme cases, 8 inches enough for all ordinary cases. Walls should start on a footing far enough below ground level to prevent disturbance from frost. Floors may be 4 inches—which is thick enough if no trucking is to be done over them, but in the latter case an added inch would be preferable. Slabs should not be larger than 6 x 6 feet.

Although the benches shown in this design represent monolithic cement construction, some prefer the sectional benches,



CROSS SECTION

which can be assembled or dismantled as desired. Sectional benches can be molded in spare time and erected when needed. Ordinary laborers with competent supervision, can make them. Earth can be rapidly shoveled from them. They do not deteriorate in or out of use, and afford no lodging for vermin.



Side elevation of good form of covered pit

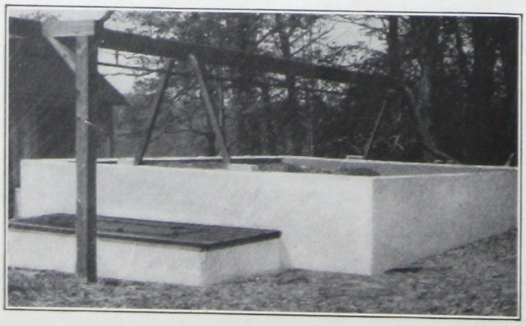
Unless firmly set, the monolithic bench may, as a result of settlement, crack, especially if not properly reinforced, while if the sectional bench is subjected to settlement none of the parts of which it is composed will be injured. It is also unnecessary to provide special drainage facilities in the sectional bench, while in the monolithic type, some form of perforations must be provided in the base or floor of the bench to permit drainage and proper aeration of the soil.

In a cement greenhouse, there is no rotting or fungus growth, which may bring on plant diseases. Cement floors and benches are easily cleaned by washing.

Manure Pits

Cement construction is ideal for the proper handling of manure until it is convenient to haul it out to the fields. Every particle of the liquid content which contains the greater proportion of the fertilizing elements, can be preserved and restored to the soil.

Usually a manure pit is constructed in some manner after the accompanying sketches, that is, either with or without a roof, and with a sump or cistern into which the liquid contents will drain and from which they can be pumped for sprinkling on the land when convenient. It is quite desirable to roof the pit and screen it with fly screen fabric, to prevent the manure pile from becoming headquarters for fly breeding. This is especially true on the dairy farm, where milk must be cared for in a sanitary manner, which means keeping flies down to a minimum.


Manure pit on farm of Haverford College (Haverford, Penna.) constructed with ALPHA CEMENT. In front is tank from which liquid manure is pumped

Manure pits should be conveniently located with reference to the barn so that if desired litter can be carried directly from the stable to the pit by a litter carrier, as shown in two of the accompanying views. The inside wall face of the pit should be sloped and all corners slightly rounded so that the manure can be properly packed in the pit to thus control decomposition. Some pits are built without a wall at one end and the floor sloped upward to ground level so that a wagon can be backed in for loading. In most cases a relatively shallow pit is best; that is, one where the manure cannot be piled to a greater depth than 3 feet.

Home Sewage Disposal Systems

Wherever a residence can be connected with a city or town sewer system this is, of course, the ideal way to dispose of house wastes. But where the advantages of a sewer are not available, as in the case of homes in sparsely populated communities or farming districts, a home sewage disposal system employing a septic tank and filter bed, will be found entirely satisfactory. In fact it provides the only really safe method of disposal in such cases, and without it modern plumbing is an impossibility in the farm home.

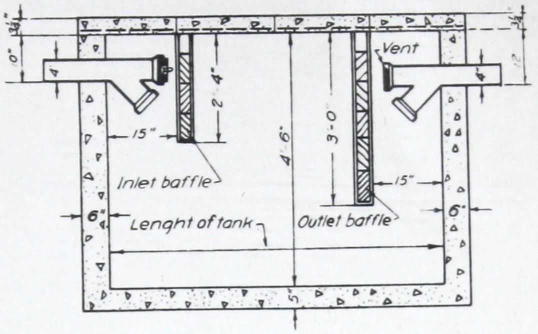
ALPHA CEMENT — HOW TO USE IT

The accompanying type of tank has been found simple and efficient, but it must be borne in mind that the tank is only half the equipment needed for continuously successful disposal.

The septic tank may be considered as merely a receptacle in which the bacteria of decomposition, "anaerobic bacteria" as they are called, may perform their work under most favorable circumstances. Best results are obtained when there is practically no supply of oxygen and as little disturbance as possible in the tank. When the contents leave the tank the solid matter has been entirely broken down, the effluent usually being a clear but not entirely purified liquid. The "aerobic bacteria" which live in the irrigating system complete the process by purifying the liquid, so that as it travels through the ground, (or sometimes even evaporates on the surface although not recommended) there is no danger of disease.

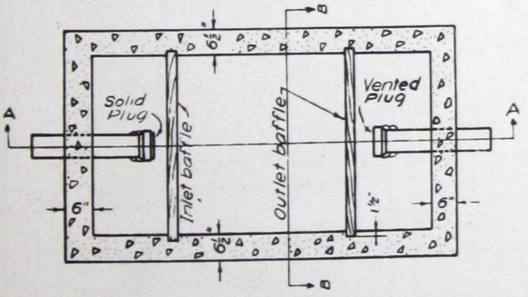
"Concrete in Home Sanitation" by the Portland Cement Association recommends: "The smallest size of tank that is practical is one for a family of five persons, which, upon the assumption that the average sewage production is 50 gallons per person, should have a capacity of 250 gallons if the general practice of sewage retention for at least 24 hours is followed."

The walls and floor of the tank should be made six inches thick and reinforced with ¼-inch steel rods spaced 12 inches apart in



Sectional sketch of a single chamber septic tank. Intake, to left, is connected to house plumbing. Outlet, at the right, is connected to sub-surface irrigation system

both directions, or with heavy woven wire. The reinforcement should extend down the walls and across the bottom, forming a sort of a basket. The cover should be not less than 4 inches in thickness, and reinforced with ¼-inch rods. For facility in cleaning, the cover should be made in slabs that may be easily removed. In case the tank must be set at considerable depth, with the weight of several feet of soil upon its top, the cover must be made thicker and stronger than mentioned.



Plan of the single chamber septic tank

Dimensions for Septic Tank and Length of Irrigation Tile

For tanks of the type shown in accompanying sketches, the dimensions in the table below are recommended for various capacities. Subsurface irrigation lines should be of approximately the length indicated.

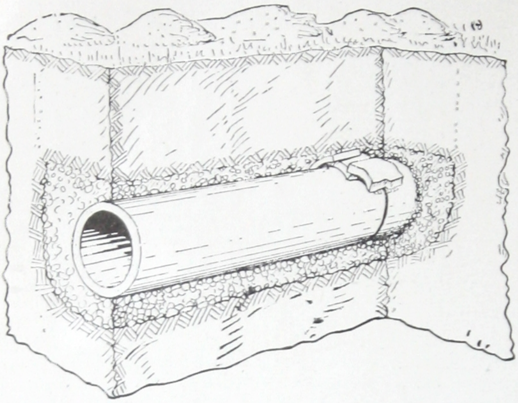
Since the efficiency of these tanks is very greatly increased by undisturbed periods, the capacity for school house installations, for example, may be approximately trebled. Thus a school with about 60 pupils would require only a 1000 gallon tank.

The Irrigation System

Various methods of distributing the effluent from the tank are in use, perhaps the simplest and most effective being to discharge it into a line of drain tile from which

DIMENSIONS OF SEPTIC TANKS

Maximum Number of Persons	Capacity in Gallons	Length (from Intake to Outlet)	Width	Depth	Length of Tile Line	
					Open Soil	Tight Soil
5	250	4 ft.	2 ft.	5 ft.	150	250
10	500	3 ft.	5 ft. 4 in.	5 ft.	300	500
15	750	3 ft. 6 in.	6 ft. 10 in.	5 ft.	450	750
20	1000	4 ft.	8 ft.	5 ft.	600	1000
25	1250	4 ft. 6 in.	9 ft.	5 ft.	750	1250

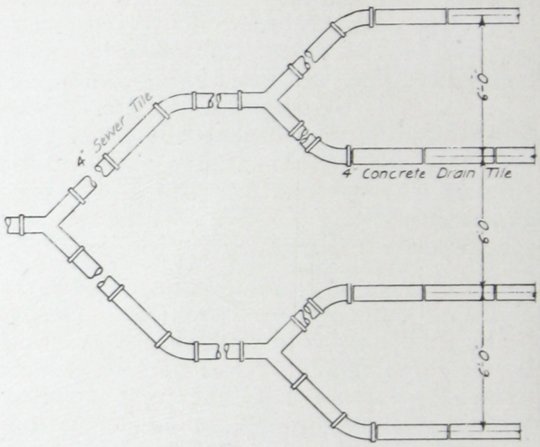


The tile are laid in six or eight inches of gravel or broken stone. Observe tile over joints

it may seep through a bed of gravel into the earth. The length of the tile line required to properly take care of the effluent is indicated in the foregoing table presupposing that there is a drop of one foot for every 25 feet of tile or thereabouts. The tile are laid a quarter of an inch apart, like drain tile, on a bed of gravel or broken stone, the slope of the line being carefully checked to make sure that it is uniform.

If the tile are installed as indicated abundant aerobic bacteria will live in the tile and the surrounding stone and soil. They require only sewage and oxygen to thrive and thoroughly decompose and purify the liquid effluent of the tank.

The septic tank is often placed near the house and a tight sewer line laid to connect it with the sub-irrigation system. In flat locations the tank is placed as high as possible in order to afford maximum pitch for the tile lines; where it is impossible to get about four feet drop from tank to end of lines, an automatic syphon or flush tank chamber is installed which retains the tank effluent and intermittently flushes it.



This method of tiling gives a large irrigation area for relative short length of tile

Construction view of two-chamber septic tank

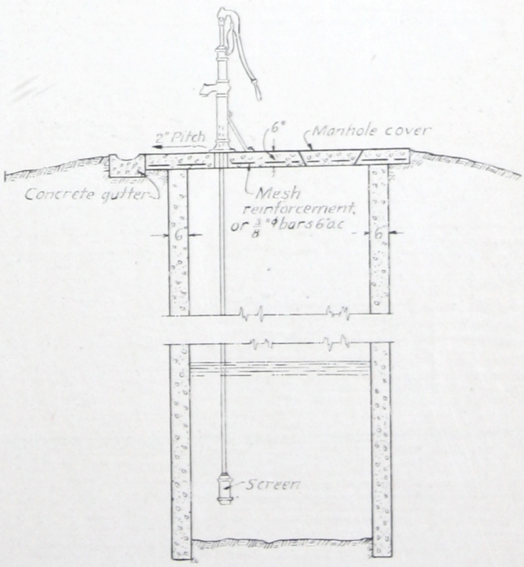
ALPHA CEMENT — HOW TO USE IT

Durable cement tables at auto campgrounds

Cement Work for Tourist Camps

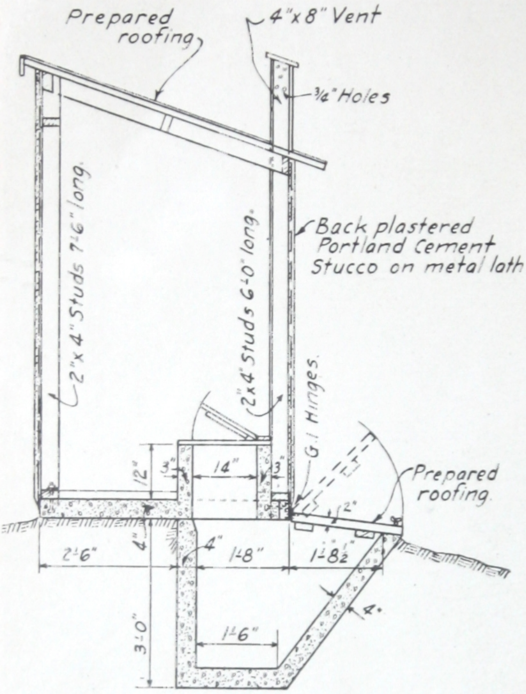
Good roads have made possible cross country touring by automobile, and improved tourist camps will add much to the pleasure of such trips. Camp ground equipment should be as nearly as possible weather resistant, fireproof and sturdy enough to withstand hard usage. Permanent tables and benches, provision for water, toilet facilities, stoves, refuse burners and washing platforms, are some of the facilities that every camp should have. Most of these improvements are applicable to private camps, fishing and hunting lodges as well as to public camps for auto tourists.

Cement tables and benches are simple to make, the tops and pedestals being cast separately in wooden molds. The molds for the pedestals are made so that the latter are cast with outer side or face down. The mold may be made of even simpler design than shown here, the various parts being held together with screws so that they may be loosened to permit easy removal of the piece. The tops are merely flat slabs reinforced with rods as shown in the sketch.

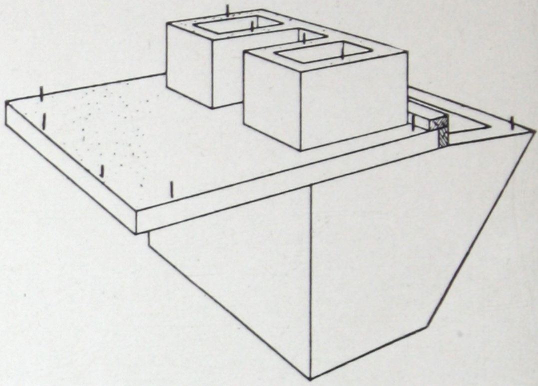


Cement well lining and pump base protect the water supply

ALPHA CEMENT — HOW TO USE IT



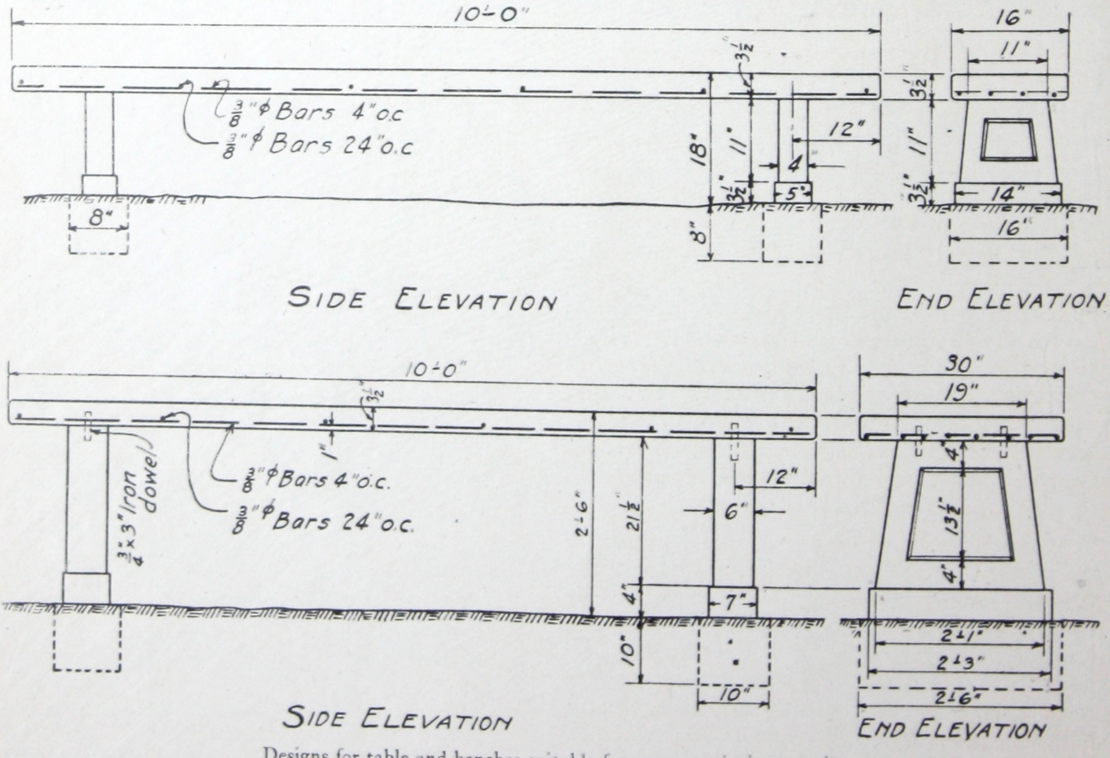
Cement vault prevents disease



Perspective sketch of vault

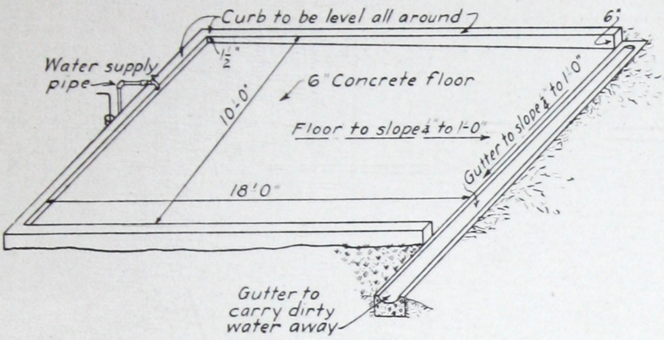
They may be conveniently cast on a smooth floor, using dressed 2 x 4's on edge, for forms. The latter must be sufficiently braced, of course, to prevent spreading. Paper laid on the floor will do away with any possibility of the concrete sticking to the floor. The tables and benches should preferably rest on small cement footings to prevent them from settling.

If water is obtained from a well or spring, care should be taken to protect the source of



Designs for table and benches suitable for camp or picnic grounds

ALPHA CEMENT — HOW TO USE IT



Automobile washing floor

supply from pollution. Cement well curbing and pump platform may be built as shown in the accompanying sketches, the most convenient method of lining the well being by sinking cement pipe.

In describing forms for making a cement well lining in place the National Builder says:

"The forms are usually made of long thin narrow boards attached to wooden discs resembling barrel heads. These discs are commonly 24 inches apart, each disc having a diameter one-half inch less than that of the one above, to prevent binding when the form is removed. The surface of the form must be smooth and well oiled."

The pump platform is made like a sidewalk slab, always being provided with drain board and gutter.

Where sewer connection is not available, the vault shown in accompanying drawings, recommended by the U. S. Public Health Service, may be used. The form work is simple but must be made so that it may be easily taken apart for removal. Bolts are embedded at various points for attaching the superstructure.

A cement cook stove is easy to build and will not need repair. In a large camp several stoves may be made and connected with the same chimney—preferably of cement chimney block. Materials for metal grates and tops are procurable at hardware store or tin shop.

A cement washing platform makes it possible for the camper to remove the dust and dirt of the road from his vehicle and affords a place where he may make minor repairs if necessary.

Cement Dams

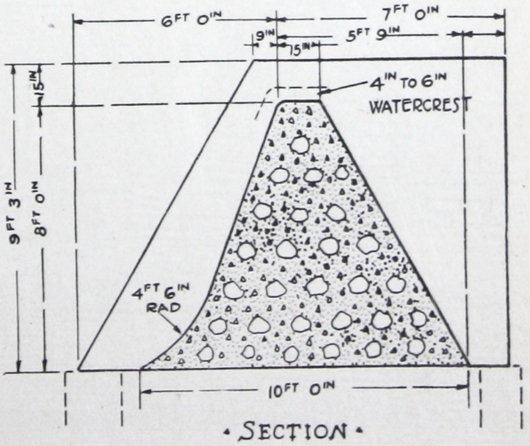
A small dam on many a farm would help to form a pond from which the home supply of ice might be harvested. Then too, such ponds may be used for fishing, swimming, rowing, etc. The design of such structures depends much upon conditions at the actual site of the work.

Dams must be heavy enough and sufficiently anchored to oppose a force of water standing against them, to prevent being moved from their foundations or from being toppled over. A dam must be so designed that the flow of water over the crest will, when falling down the face strike in such a way as to be at once directed downstream. This is accomplished by shaping the face to a curve that deflects the water into the stream bed, or by building an apron on the lower part of the dam to prevent the falling water from pounding at the base and weakening or undermining the foundation.

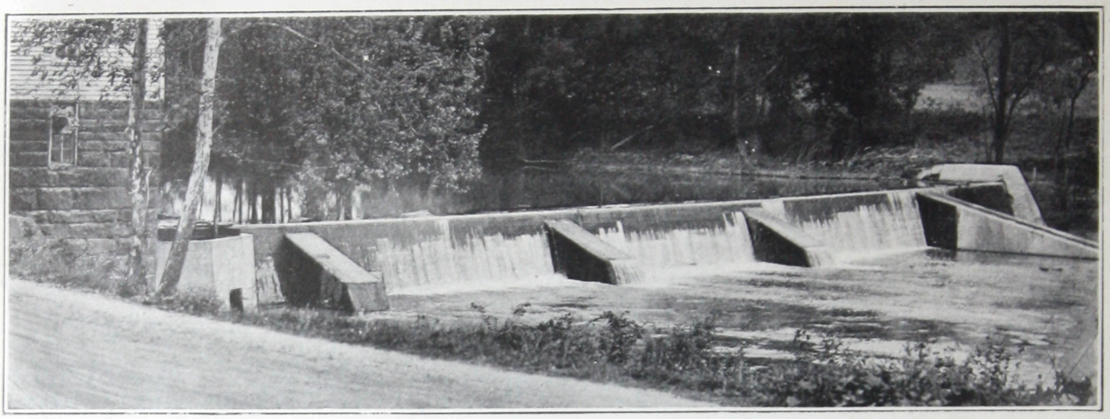
Sometimes dams are destroyed by the freezing of impounded water and unless exceptionally massive construction is used, reinforcing is necessary to prevent injury from the stresses caused by the expansion when ice forms in the pond.

In the best types of construction, the upper face of the dam is battered, that is, sloped so that the ice will rise when forming and thus relieve the dam from the pressure of expansion.

In most cases the home worker will find it inadvisable to attempt the planning and construction of a dam. Some competent



Section of small cement dam



One good style of construction

engineer should determine foundation conditions and requirements and suggest or design ways and means of anchoring the dam.

Rollers of Cement

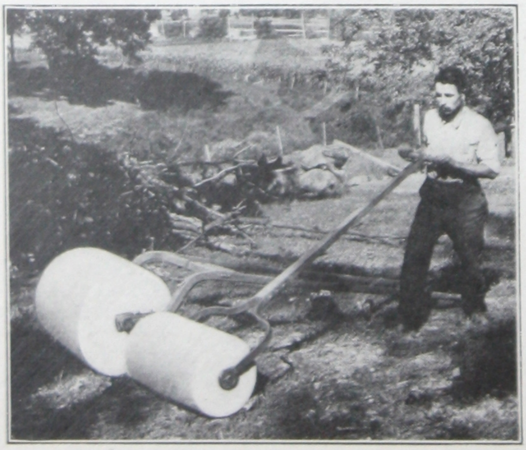
Rollers were originally made from logs of wood. These were abandoned for the more expensive iron rollers. Today these are being largely replaced by cement rollers.

A cement roller is practically indestructible and will never have to be replaced. It will not rust or rot, and is always ready for use.

Obtain a length of sewer pipe, of the size of roller desired. A tile from 12 to 24 inches in diameter will usually suit the purpose. Set this tile on end, small end down, on a wooden platform. Through a hole bored in the platform insert a 1-inch round iron bar, long enough to project beyond the ends of the roller a sufficient distance to provide bearings and attachment for the handles. Care should be taken to get the bar exactly in the center of the tile before placing concrete, and to keep it there while the concrete is being placed. Make a wet mixture of concrete and fill the tile with this mixture, up to the "bell" of the tile. Allow the concrete to set for ten days, when the roller may be placed on side, and the bell of pipe chipped off with a cold chisel and hammer. Attach a forked handle as shown in the illustration. As the axle is a firmly-fixed part of the roller, the fork ends of the handle must be provided with holes, within which the axle can turn.

A roller 18 inches in diameter and 2 feet long will weigh about 600 pounds. If a lighter roller is desired, use a smaller sized sewer pipe; or place several small pipes inside the large one, depositing the concrete around them on the outside. They will form hollow spaces inside the roller and lessen its weight.

By increasing the size of pipe, or by using a steel mold and attaching a pair of shafts or a tongue instead of a handle, horse rollers may be made for crushing the clods in the ploughed fields.



Cement lawn rollers are easily made

Put idle sand and pebbles to work. Bind them together with ALPHA CEMENT into indestructible yard and farm improvements.

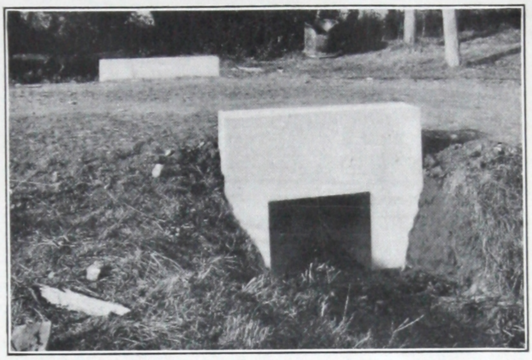
ALPHA CEMENT — HOW TO USE IT

Culverts and Small Bridges

Culverts or bridges of various size are necessary where highways must cross streams in order to take care of only the natural flow of streams, and to provide for flood periods in so far as possible. There is also often a demand for small bridges or culverts on farms where provision must be made to drive team or truck from one field to another where the two are separated by a stream.

The simplest form of cement culvert is that made of pre-cast cement pipe. Such a waterway opening is adapted to all opening requirements from 12 inches up to the largest size of pipe made, providing other conditions would permit the use of this type of waterway opening. Common practice limits the minimum size of waterway openings to 12 inches because smaller sizes so easily become choked with refuse or rubbish carried by the stream.

Next to the pipe culvert comes the box culvert. This is very simple to build because no complicated forms are needed and the cement work itself is simple. It is merely a long box or trough with cement sides, top and bottom and open ends or a small cement bridge in which the top slab acts as a floor to support the loads of traffic. The slab must be reinforced with steel rods or heavy steel mesh. Every box culvert should have a cement floor at the bottom to prevent damage to the entire structure from undermining by stream flow.

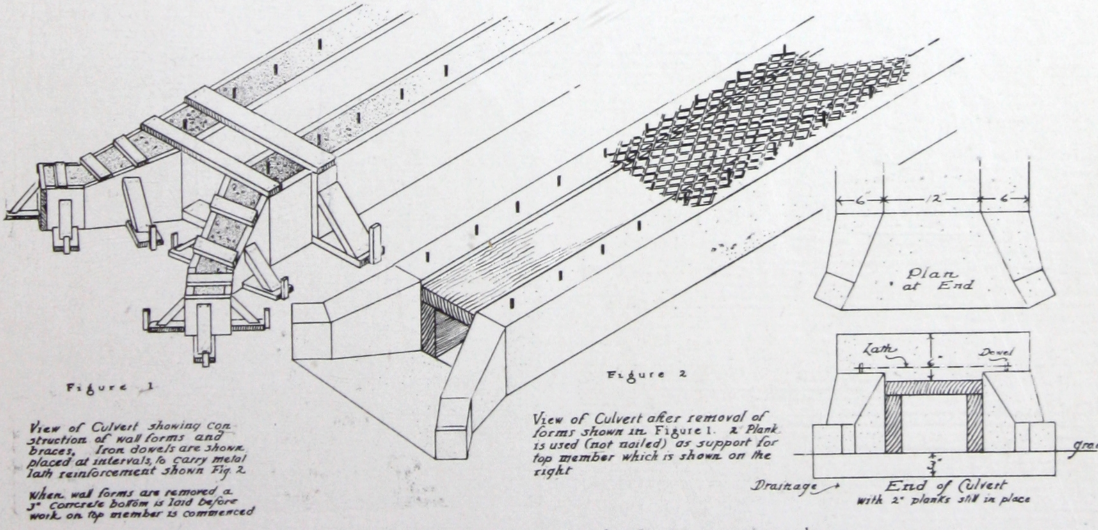


Cement culverts may be made square or round

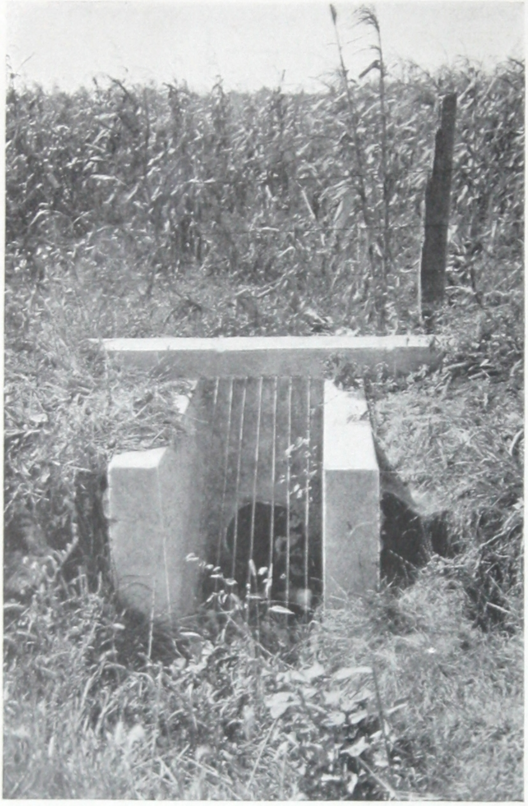
There are also culverts of the arch type in which the top is in the form of an arch instead of flat slab. There is no advantage in the arch culvert for small spans unless it is that the small arch requires no reinforcing because the concrete is placed in such shape as to take care of all load put upon it as compression. Naturally it is a little more difficult to build forms for arches than for box culverts.

When cement pipes are being laid for culverts, a carefully prepared trench should be dug, properly curved at the bottom so that pipe may be everywhere embedded at the required level.

Wing walls are usually provided on bridges and culverts to retain the road fill and protect it against stream erosion. A culvert or bridge should, if possible, be in-



Methods of building another good style of square opening culvert



A screen will prevent rubbish filling a culvert or perchance its selection by some animal as a permanent home

stalled at right angles with the road so as to make wing walls straight and parallel with the road. A vertical cut-off wall should be placed at each end of the floor in a box culvert extending down two feet into stream bed below the upper level of the floor as added precaution against undermining. In building small culverts the floor is usually made continuous with the walls and thus acts as a foundation. All culverts should have at least two feet of fill over them to help distribute traffic loads, unless, of course, the highway is paved with cement, in which case the top slab of the bridge or culvert is usually designed as a continuation of the highway pavement.

Many of the foregoing statements apply fundamentally to bridges. The term "bridge" is usually applied to a structure larger than one commonly called a culvert. Since every location requiring a bridge involves some different conditions than every other location, it is not possible to standardize bridge designs except within narrow limits of dimension. In other words, bridges that do not need to be more than 16, 18 or 20-foot span can be fairly well standardized so that almost any design for a small structure of this kind can be adapted to practically any location with but minor changes.

The flat slab bridge is probably the simplest form and is particularly suited to the short spans and loads of ordinary highway traffic. It is merely a cement slab of proper thickness, suitably reinforced and resting on abutments. Form work is simple.

Most highway departments have developed standard designs for small culverts and small bridges. From such designs one suitable for the bridge or culvert requirements of any location can usually be selected.

A very important precaution to take in connection with bridge construction is that forms shall be left in place until there is no doubt that the concrete has acquired the strength necessary to support the loads to which the bridge will be subjected when put in service.

Facts About Cement Roads, Streets and Alleys

At the present time the construction of cement pavements for roads, streets and alleys, is progressing at the rate of about 7,500 miles a year. Considering the fact that there are over two and one-half million miles of all kinds of roads in the United States, these figures may not seem very impressive. They have more importance,

Cement pool for water-lilies

ALPHA CEMENT — HOW TO USE IT

however, when one realizes that prior to 1920 the total of all cement roads in the United States built since the first road of that type was laid, amounted to only 10,787 miles. Also, it is only within the past two or three years that the building of really permanent roads has received its impetus.

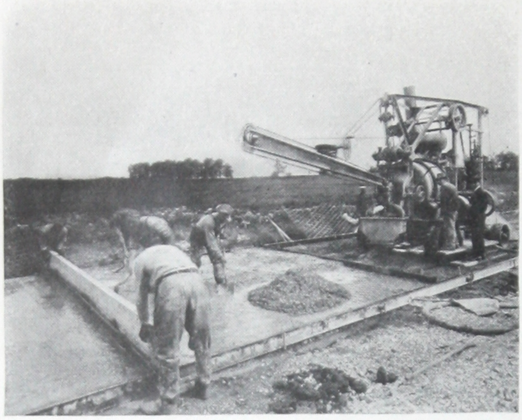
The word pavement must be taken in its true sense and not confounded with the commonly used expression "hard surface" There are many types of hard surfaced roads, gravel, macadam and a variety of patented types, depending upon bituminous materials as a binder, etc. Most of these types have proved wholly inadequate to meet the demands of the changing traffic of recent years. The horse, which means the horse-drawn vehicle, has all but disappeared from our more thickly settled communities. Even the farmer keeps the horse mostly on the farm and makes his trip to town by automobile or motor truck. It is these vehicles that have transformed highway traffic and hence compelled new standards of highway construction. Wherever it has been used, and that means in all states of the Union, cement pavement is recognized as possessing more desirable qualities than are found combined in any other paving material. It is often referred to as the type of road having the maintenance built into it, and that this manner of referring to it is justified is proved by all figures covering highway maintenance cost for various types of construction. The cement road costs more to build than some other types but is worth more because first cost is not the sole criterion. Final cost is the test; and over a period of years the cement road has proved everywhere least expensive. Construction costs as well as basic costs in every field have changed greatly in recent years. These changes however, have not affected the comparative cost of cement construction, since materials competitive with it have risen in cost also leaving concrete still in the same relative position with respect to its ultimate cost. In fact it has often been proved within the last year or so that even in first cost cement pavements can compete successfully with proven less durable types of hard surfacing.

A cement road is nothing more nor less than an extension of cement side walk designed to embody the qualities that will take care of the different requirements of vehicle traffic as compared with pedestrian

Contractor R. H. Gumz

Eighth Avenue Road, Milwaukee Co., Wis. ALPHA CEMENT used exclusively

ALPHA CEMENT — HOW TO USE IT



Laying a cement road

traffic. Cement roads are thicker than sidewalks, are often reinforced, should be built from 18 to 20 feet or more in width, depending upon the volume of traffic to be provided for, should be laid with particular care to the most highly developed drainage of the subgrade possible, and particular care should be given to selection of materials, proportioning, mixing, placing, finishing and curing the concrete. It is not possible with any other type of construction to produce a road surface having the evenness, skidproof texture of surface and permanence that result from the use of concrete laid according to the Standard Specifications for Cement Road, Street and Alley Construction.

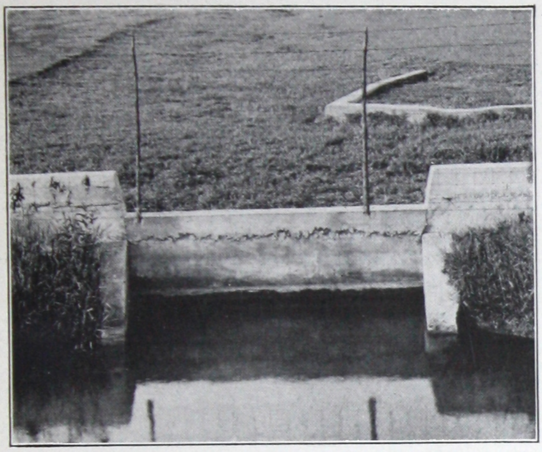
Just as cement possesses superior qualities as a road paving material, so does it display the advantages of these qualities in street and alley paving. It is comparatively low in first cost, clean, dustless, maintained at trifling expense, sanitary, skidproof—the safety-first pavement. It is not affected by extremes either of heat or cold. The surface is so dense and impervious that cement pavements require but little crown to insure quick free drainage. Therefore, all of the paved area may be used by vehicles with equal safety. Nothing has to stand harder wear than roads. Cement construction has all the qualities that resist wear and hard usage. That is why the cement road is increasing more rapidly than any other type of so-called highway pavement.

A community advertises itself effectively (well or ill) by its roads.

Contractor, Wm. Eisenberg

76-foot ALPHA CEMENT street, Vineland, N. J.

ALPHA CEMENT — HOW TO USE IT



An improvement that stands year after year

Cement in Land Drainage

Millions of acres of untilled land can be brought into profitable cultivation and the yield from additional millions can be greatly increased by systematic drainage. In this work cement plays an important part, for cement drain tile are considered today as the high quality product in this field. Cement tile are always straight and true to shape, thereby insuring a much greater capacity than misshapen tile which match poorly with adjoining sections, increasing line friction and cutting down the effective area of the line.

One marked characteristic of cement tile is their ability to resist frost action or alternate freezing and thawing conditions. There are numerous examples of cement pipe and tile drains in use 50 years or more and which so far as the cement itself is concerned are still in perfect condition, giving evidence that cement pipe and tile possess in the highest degree the durability necessary to such a permanent improvement as land drainage.

Occasionally one hears that cement pipe or tile will not withstand the action of alkali or certain soil acids. It is true that cement tile have been found almost completely disintegrated, but the causes have usually been quickly ascertained as due to the use of too little cement in the mixture, too dry a mix, unsuitable aggregates or failure to properly cure the product after removal from the mold. Today the products of every reputable manufacturer of cement drain tile may be depended on to meet the standards of the American Concrete Pipe Association.

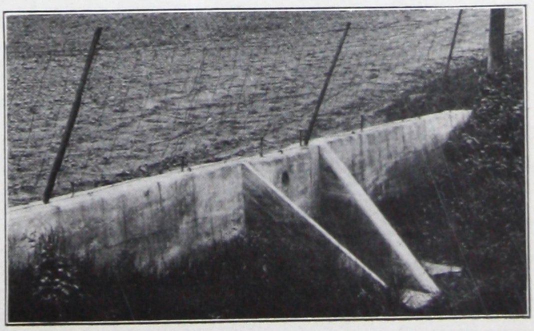
Contrary to the mistaken belief of many users, tile to be of good quality must be dense and have low absorption. Water enters the line through the small openings left between tile and never properly through the walls of the tile themselves. Before undertaking to lay tile the inexperienced operator should consult his state agricultural college, in addition to securing "Concrete Tile for Land Drainage" (free) by the Portland Cement Association and the comprehensive bulletin on "Land Drainage" by the U. S. Department of Agriculture, Washington, D. C.

The manufacture of cement drain tile is not recommended to the home worker in concrete. It is a process requiring especially skillful treatment and the employment of expensive factory methods beyond the economical reach of the private user.

To Prevent Soil Erosion

Cement walls are often very useful in preventing soil erosion, thereby protecting fertile acres from becoming unproductive. A low retaining wall, carefully buttressed to withstand soil and water pressure, and provided with one or more openings or a spillway to take the run-off, is usually all that is required. The wall must be started below frost penetration, on firm soil. Wing walls and buttresses are frequently required for stability and reinforcing is customarily employed.

The agricultural engineering departments of practically all agricultural colleges are prepared to consult with farmers relative to erosion problems and to provide them with precise information and plans based on the necessities of each individual situation. In general these walls are built in the same manner as light dams.



Dampness helps rather than harms concrete

ALPHA CEMENT — HOW TO USE IT

Thirty-inch cement sewer pipe. Cement pipes are characterized by smooth interiors and trueness to shape, prime essentials for first class sewer work

Cement Sewers and Cement Sewer Pipe

Probably no municipal work calls for better or more durable construction than a sewer system. It is for that reason that concrete, both in the form of monolithic construction and cement pipe is used so extensively in sewer work. Other materials also are used but there is no doubt that a very large majority of sewers in all cities of the country have involved the use of concrete more extensively than of any other material.

Very large sewer mains, such as used for the principal channels of extensive city sewerage systems are often built of monolithic construction, the design of such sewers being an engineering proposition. However, very large cement sewers are made of cement pipe because advance accomplished within recent years in the manufacture of this product has been wonderful. At the present time between two and three hundred cities in the United States use cement pipe exclusively for sewers.

Many types of cement sewer pipe are manufactured. These differ, however, principally in the methods used to form joints and in the manner of reinforcing the pipe. Some types are circular, some oval, some combined oval and flat sections. Some pipes are hand made and some are made by machine. Various methods, some of which are patented, are used to form joints. Some pipes have bell and spigot ends, others have plain ends which interlock in various ways, usually provided for when the pipes are manufactured. Regardless of form or shape, the value of cement sewer pipe, like any other cement product rests largely in its quality. This is dependent entirely upon observing proven requirements of manufacture. No compromise should be made in the matter of correct proportions, clean, well graded materials and proper consistency of concrete, and finally, proper curing of the finished product.

Sewer pipe of large size, especially those above 24 inches in diameter are usually manufactured by the hand-tamp process often at the site of the work and in special forms provided for the purpose. These usually consist of properly shaped steel plates with the inner form so placed within the outer one that the shell of the finished pipe will be of the desired or required thickness.

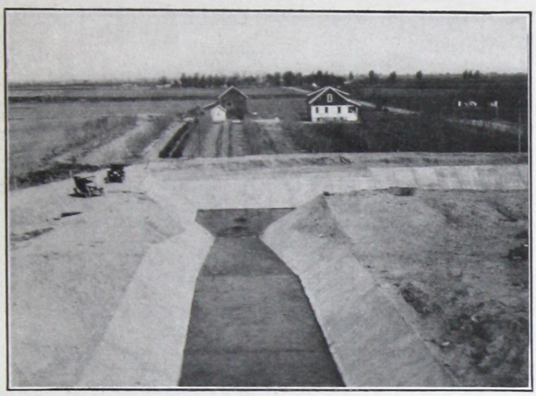
Suggested specifications for cement sewer pipe, as well as for pressure and culvert pipe may be obtained on request by anyone interested.

Cement in Irrigation

Those of us who are in the habit of living where rainfall is frequent and ample for all crops usually grown, can hardly appreciate the money value which water has in many sections of the arid west. In those sections, water is really a marketable commodity, and millions of dollars have been expended in building huge storage reservoirs of which cement dams are a feature, merely for the purpose of conserving water so it may be distributed where and when most needed for irrigation. Many of the so-called reclamation projects which have been carried on by the U. S. Government have made available for agricultural pursuits millions of acres of land saturated with fertility but which could not contribute that fertility to agriculture because of limited or no rainfall in the part of the country in question.

With such a value placed upon water in these arid and semi-arid sections, every means is used to conserve local resources, and in that conservation cement has long played an important part. The loss of water through seepage in earth canals is very great. Wood linings were used at one time quite largely to prevent these seepage losses but timber was expensive and short lived and for this reason proved inefficient because involving high cost of maintenance. Now, no irrigation project is planned or put

ALPHA CEMENT — HOW TO USE IT



Cement linings for irrigation canals reduce water wastage to a minimum and increase the speed of flow

into operation without making extensive use of concrete to line main canals and laterals. In some cases underground cement pipe lines operate in place of open ditches. Even though the flow area of ditches is lined with concrete, there is nevertheless often considerable evaporation of water in transit. Where such losses are great, it is desirable to prevent them as well as seepage losses.

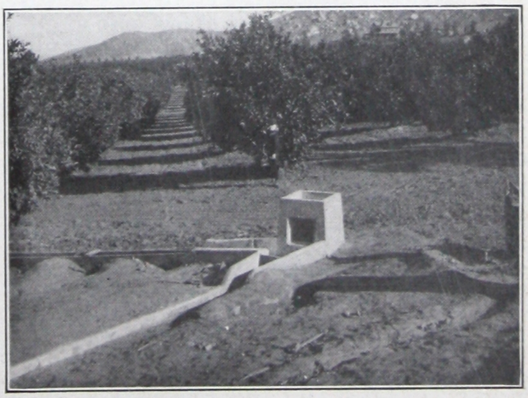
The Portland Cement Association has published a booklet entitled "Concrete for Irrigation Canals" which sets forth at greater length the various advantages of concrete in this field of use and the many pictures in this booklet illustrate how extensive that use has been. Certain details of construction are shown and methods of construction described. We shall be glad to send a copy of this booklet to anyone interested.

Cement in Mines

Cement has long been used extensively in mine workings both above and below ground. In any mining operations, underground fire particularly is always to be dreaded. Liability of fire is greater in some classes of mines than others, notably in coal mines, but in any event precautions must be taken against fire because of the probable loss of life that would follow the burning of underground structures. The word "structures" in this sense is used to refer to mine props, shaft linings and hoisting stations or any other workings where timber has been and formerly was the material most used to keep the portions of the mine being worked from caving or falling in.

In most mines the conditions of the atmosphere with particular reference to dampness are ideal for the rapid rotting of timber. At one time timber was preferred as a material for all underground as well as above ground structural purposes in mining operations. There was a logical reason for this since in most mining sections in the early days the surrounding country was well covered with timber. Therefore such material was right at hand and cost practically nothing. However, its short life in use made the maintenance high, and in the end timbering proved most expensive. Many disastrous fires also pointed to the wisdom of preventing a recurrence. The result was a gradual turning to cement which in recent years has been followed by most wonderful development of the use of cement in mines. Shafts are now completely concrete lined, underground timbering is all of concrete, tunnels are lined either with monolithic concrete or by a layer of concrete of varying thickness applied by means of a cement gun or similar apparatus, and all structures above and below ground on a mining property that promises long time operation are made permanent, maintenance free and proof against fire by exclusive use of concrete.

The ALPHA dealer of your community is a cement-service man. Call on him freely for any additional service needed.



Cement distributing gate from which the water reaches the lateral lines in the fields and orchards

ALPHA CEMENT — HOW TO USE IT

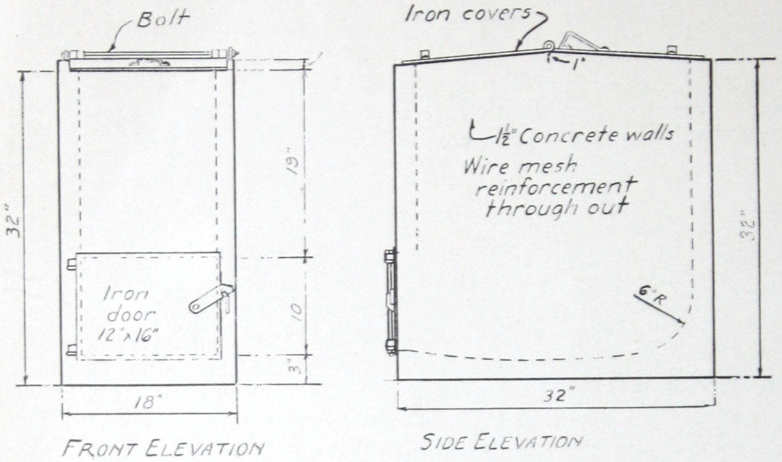


Fig. 1. Design for a cement garbage container which should have a large sale in every city. The cement box is sanitary and indestructible and will last a lifetime

Salable Garbage Box

Most garbage boxes have been made of wood or galvanized sheet iron—both materials short lived and otherwise poorly adapted for the purpose. Wooden boxes harbor rats and soon become decayed, odor-infested and rickety; metal boxes become battered out of shape, rust out, develop sharp edges and allow filthy liquids to leak out. A well made cement box is superior to all others because it is good looking, permanent and odor-proof, and can be burned out or otherwise disinfected if ever required.

The receptacle shown in accompanying drawings is 18 inches wide, 24 inches long and 32 inches high, outside measurements. The side walls are $1\frac{1}{2}$ inches thick and the bottom has a minimum thickness of two inches. The thickness of the bottom at the opening in the back of the box is three inches, the floor being rounded in order to retain liquids and smoothed to facilitate cleaning.

Boxes of this size containing a free space volume of about $7\frac{1}{4}$ cubic feet are ordinarily rated at 55 gallons capacity and are large enough to take the pure garbage from any private residence or from at least four ordinary city apartments where collections are made regularly. The doors are made of 14-gauge or 16-gauge galvanized steel plate attached by means of bolts and straps embedded in the concrete. The back door has a catch easily opened and fastened with the collector's shovel.

This box is perhaps most easily molded in an upright position as it appears when in use. The outer form should be made in four pieces of heavy sheet steel, at least 10 or 12 gauge. These should be riveted to angle iron or attached by screws to 2 by 4 ribs and designed so that all four sections can be rigidly and tightly joined together. The inner form is made in two sections, the larger section taking care of all of the inner surfaces except the opening for the clean-out door. This larger section is made of sheet iron on a wooden frame which collapses in two directions and has a slight taper in the other two directions. The smaller section of form which provides for the clean-out opening is made of wood covered with sheet steel and is dowelled by means of two small steel pegs, to the larger section. This smaller section is withdrawn first through an opening in the outside form. The larger section of the inner form is then carefully withdrawn vertically by means of a chain hoist and the outer forms then removed. The surface is immediately patched, painted with a cement wash and cured for at least two weeks.

Reinforcing for these boxes usually consists of a basket or heavy $\frac{1}{4}$-inch mesh galvanized steel wire of either square or triangular shape.

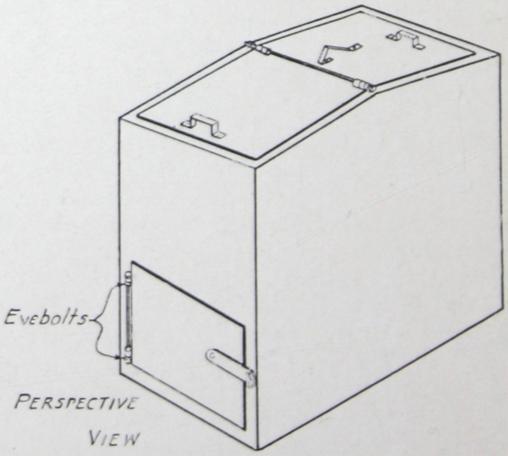


Fig. 2 Perspective of the box shown in Fig. 1 showing the sheet steel doors and methods of attaching

Valuable Bulletins of the Portland Cement Association

The Portland Cement Association, of which the Alpha Portland Cement Company is a member, issues a number of valuable treatises that are supplied free of charge to those interested. In the belief that many of these documents will be of particular interest to readers of this Handbook, the following list is printed:

ABOUT THE HOME

Plain Talk about Beautiful Homes
Concrete Around the Home
Plans for Concrete Houses (price 50 cents)
Concrete Garages
Portland Cement Stucco
Manual of Concrete Masonry Construction
Concrete in Home Sanitation
Tennis Every Day on Concrete Courts
Concrete Swimming and Wading Pools

ON THE FARM

Concrete Tile for Land Drainage
Concrete for Irrigation Canals
Concrete Silos—Monolithic and Block
Concrete Stave Silos
Concrete on the Dairy Farm
Concrete on the Hog Farm
Concrete for Poultry Houses
Concrete Fence Posts
Plans for Concrete Farm Buildings
Permanent Repairs on the Farm

FOR STREET AND HIGHWAY

Specifications for Concrete Roads
Specifications for Concrete Streets
Facts about Concrete Roads
Concrete Streets for Your Town
For Your Alley—Concrete
Maintenance of Concrete Pavements
Concrete Pavement Construction in Hot Weather
Concrete Curb and Gutter Construction
Concrete Roads and Your Money's Worth
Concrete Highway Grade Crossings
Precautions for Concrete Paving in Cold Weather
Concrete Highway Bridges
Concrete Pipe Sewers

FOR INDUSTRIAL PURPOSES

Mercantile and Industrial Buildings of Concrete
Concrete School Houses
Concrete Hotel, Apartment and Office Buildings
Concrete Chimneys
Concrete Tanks for Industrial Purposes
Concrete Tanks for Fuel Oil Storage
Concrete Floors
Concrete Commercial Garages
Concrete Coal Pockets
Concrete Pits for Coal Storage

GENERAL INFORMATION ABOUT CONCRETE

Concrete Data for Engineers and Architects
Standard Specifications and Tests for Portland Cement
Standard Specifications and Tests for Concrete and Aggregates
Manufacture of Concrete Masonry Units
Storage of Sacked Cement
Bulk Cement

Address:

PORTLAND CEMENT ASSOCIATION
111 W. Washington St.
Chicago, Ill.

The Alpha Portland Cement Company issues from time to time a pictorial magazine entitled ALPHA AIDS, dealing with cement improvements and interesting features of the cement business.

We do not wish to waste any numbers of this magazine, but will be glad to put on our free mailing list any engineer, architect, contractor, dealer or property-owner who has a real interest in the use of Portland Cement.

Address Service Department, ALPHA PORTLAND CEMENT COMPANY, Easton, Pa., giving your full name, complete address and your business.

ALPHA CEMENT — HOW TO USE IT

*Standard Specifications

Special Note—Cement testing should be entrusted only to persons qualified through complete knowledge of the chemical properties of the ingredients and experienced with the various stages of manufacture necessary to produce Portland Cement.

Definition—1. Portland cement is the product obtained by finely pulverizing clinker produced by calcining to incipient fusion, an intimate and properly proportioned mixture of argillaceous and calcareous materials, with no additions subsequent to calcination excepting water and calcined or uncalcined gypsum.

I. Chemical Properties

Chemical Limits—2. The following limits shall not be exceeded:

Loss on ignition, per cent 4.00
Insoluble residue, per cent 0.85
Sulfuric anhydride (SO), per cent 2.00
Magnesia (MgO), per cent 5.00

II. Physical Properties and Tests

Specific Gravity—3. The specific gravity (the specific gravity test will not be made unless specifically ordered) of cement shall not be less than 3.10. Should the test of cement as received fall below this requirement, a second test may be made upon an ignited sample.

Fineness—4. The residue on a standard No. 200 sieve shall not exceed 22 per cent by weight.

Soundness—5. A pat of neat cement, after 24 hours in moist air, when immersed in steam, shall remain firm and hard, and show no signs of distortion, cracking, checking or disintegration.

Time of Setting—6. Initial set shall develop in not less than 45 minutes when the Vicat needle is used or 60 minutes when the Gillmore needle is used. Final set shall be attained within 10 hours.

Tensile Strength—7. (*a*) Test pieces of standard mortar composed of one part cement and three parts standard sand, by weight, shall give tensile strengths equal to or higher than the following:

Age at Test Days	Storage of Test Pieces	Tensile Strength lb. per sq. in.
7	1 day in moist air, 6 days in water	200
28	1 day in moist air, 27 days in water	300

(*b*) Each value shall be the average of the results of tests from not less than three test pieces. The tensile strength of standard mortar at the age of 28 days shall be higher than the strength determined at the age of 7 days.

III. Packages, Marking and Storage

Packages and Markings—8. The cement shall be delivered in suitable bags or barrels bearing the brand and name of the manufacturer, unless shipped in bulk. A bag shall contain 94 lbs. net. A barrel 376 lbs. net.

Storage—9. The cement shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment, and in a suitable weather-tight building which will protect the cement from dampness.

IV. Inspection

Inspection—10. Every facility shall be provided the purchaser for careful sampling and inspection at either the mill or at the site of the work, as may be specified by the purchaser. At least 10 days from the time of sampling shall be allowed for the completion of the 7-day test, and at least 31 days shall be allowed for the completion of the 28-day test. The cement shall be tested in accordance with the methods herein prescribed. The 28-day test may be waived if ordered.

V. Rejection

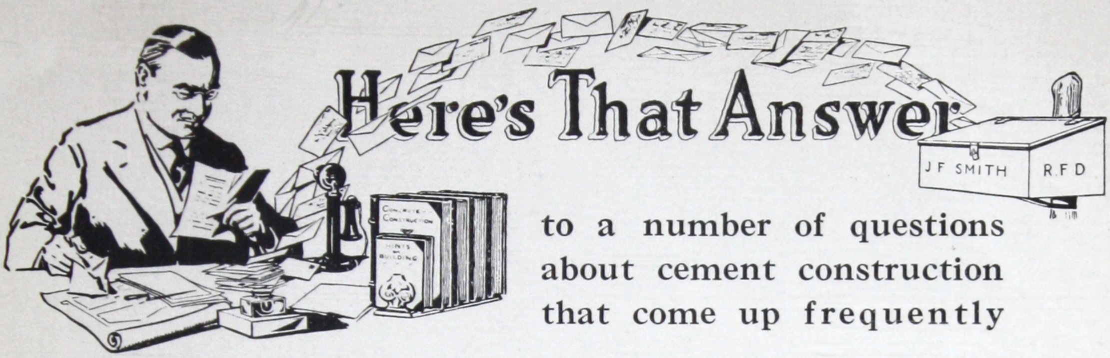
Rejection—11. The cement may be rejected if it fails to meet any of the requirements of these specifications.

(*a*) Cement shall not be rejected on account of failure to meet the fineness requirement if upon retest after drying at 100° C. for one hour it meets this requirement.

(*b*) Cement failing to meet the test for soundness in steam may be accepted if it passes a retest using a new sample at any time within 28 days thereafter.

(*c*) Packages varying more than 5 per cent from the specified weight may be rejected; and if the average weight of packages in any shipment, as shown by weighing 50 packages taken at random, is less than that specified, the entire shipment may be rejected.

* Adopted by the American Society for Testing Materials, effective January 1, 1921. Approved as "American Standard" by the American Engineering Standards Committee, March 31, 1922.



Here's That Answer

to a number of questions about cement construction that come up frequently

Where gravel must be hauled, and good sand is on the ground, does it not pay to use cement and sand exclusively? I must pay for all my hauling. How does a sand and cement mixture compare with a mixture of cement and graded gravel in strength?

IT will require much more Portland Cement to make concrete of just sand and cement than it would if stone, sand and cement are used; and stone adds strength that sand cannot supply. Strictly speaking, the result is not concrete unless some material coarser than ordinary sand is used. Concrete, as the word is ordinarily understood, refers to some kind of coarse aggregate such as crushed stone, gravel, cinder, hard slag, etc., knit together by a mortar of sand and cement. The office of the sand and cement is to fill the voids in the coarser material and to knit the entire mass together in an everlasting bond. Cement is the most expensive material used in the making of concrete, and good sand, when the job is a large one, represents considerable money. Therefore, to eliminate the coarser material will not only mean weaker concrete but ordinarily will greatly increase the cost. Even if hauling expense has to be incurred, we recommend that this inquirer use a mixture of one part cement, three parts of coarse, clean sand, and five parts of clean gravel rather than to do his work with a mixture of one part cement to four of sand, which is as lean a mixture of sand and cement as would be advisable. Concrete that contains too much sand will "dust off," especially if considerable of the sand is fine. It is always desirable to have sand that has a good proportion of coarse grains.

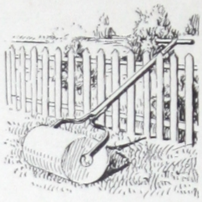
Sometime ago I put a cement floor in my stable and it has turned out to be very satisfactory, with the exception that it is rather slippery. Can I do anything to correct this fault?

Your floor may have been smooth-troweled, which is not good practice for cement surfaces that are to afford a safe footing for animals. Or possibly the grade from center to sides is too sharp. If the rise is not more than one inch in six feet, the following treatment is suggested:

Get a heavy steel hammer with a face similar to that of a shingle hatchet—that is, the face of the hammer should have the appearance of a series of pyramids, with the points approximately ½ inch apart. Chip the surface of the concrete with this hammer. The floor will then likely be rough enough to obviate the danger of slipping and it will be unnecessary to add a top coating.

If your floor has a grade or rise of more than one inch in six feet and it is deemed necessary to regrade it, first roughen the surface as above indicated. Then give the floor a thorough sweeping or washing, so as to get off all the particles of chipped concrete. After this wash the floor with clear cement and water. While this is still damp, apply a 1:2 mixture, that is, 1 part of cement to 2 parts of good clean sand. This coat should be at least one inch thick in the thinnest place and the sides as much thicker as is necessary in order to bring the floor up to the required grade. While this coat is still soft, brush it with a coarse, stiff brush or broom so as to make a rough surface.

ALPHA CEMENT — HOW TO USE IT



How can concrete be made to knit together firmly when the work is done at different times?

It is always best to arrange to have the surface or finishing coat of concrete placed before the other concrete has fully set; then there will be no trouble about getting a good bond. However, when it is necessary that a facing or extra coat of concrete be added, after the completion of the other work, the surface on the old concrete should be thoroughly cleaned, using for this purpose a solution of one part muriatic acid to three or four of water. Let this wash stay on the surface until the concrete has been etched away enough to expose the rough aggregate. In this way, the new concrete will have something on which to get a grip. Before applying the fresh concrete, flush off the rough surface of the old concrete with clean water so as to remove the acid thoroughly and keep the surface thoroughly wet until the new concrete is applied. For such work, a mix of one part cement and two of sand will give the best results.

Often, when I am trying to get a nice, smooth wall, I find that pockets have been left in the concrete, and this makes the surface look unsightly when the forms are taken away. How can this be remedied?

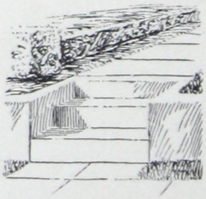
The best way to remedy this fault is while the concrete is being placed. In the first place, the mixture should be mushy enough to pack down solidly and care should be taken to see that the larger stone used in the work is mixed well up with the smaller. But even when this is done, it is best at frequent stages of the work, to take a spade or other flat tool, and work this down between the fresh concrete and the outer form. This will shove the larger stone away from the extreme edge and permit the fine material to work outward. It furthermore aids in making your concrete more dense, which is very important where the wall is expected to repel water.

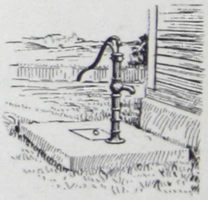
What is the best way of preventing cracks in pavements and driveways?

Probably ninety per cent of all cracks in pavements and driveways are caused by the action of frost. The remedy is a deep, well laid and well drained subbase composed of material such as cinders or ashes that will not expand in freezing.

Cracks come frequently from the neglect to provide for expansion and contraction. Concrete that is exposed to heat and cold is subject to a certain amount of contraction and expansion. The expansion joint should not be a mere ornamental line on the surface but should extend down through the slab. Some contractors provide for this by first laying only every other slab. When the first slabs are hard, the empty spaces are filled.

Fine or "hair" cracks are usually caused by too much fine sand or by excessive troweling before the cement has taken its initial set; the troweling brings the cement and fine material to the surface. Give the cement time for the initial set before beginning the final troweling. Hair cracks do not extend deep and do not ruin the walk but mar its appearance.





A few months ago I put a cement cellar wall in a house that I was building at that time. During the last week we have had some heavy rains and the water has leaked in. Is this the fault of the cement or poor mixing?

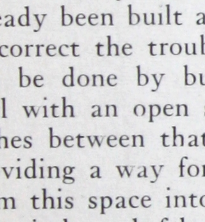
Your concrete was probably lacking in density.

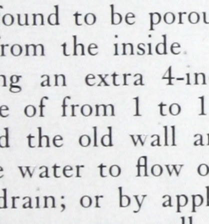
Numerous tests by various scientific bodies as well as by the Bureau of Standards of the U. S. Government have shown that the best way to secure a waterproof concrete is so to grade your aggregates

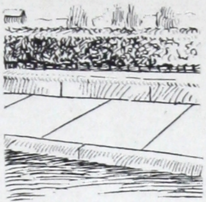
ALPHA CEMENT — HOW TO USE IT

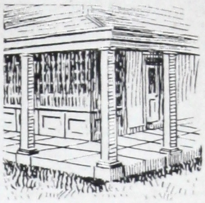
as to secure the densest possible concrete. By this is meant, use stone and sand, the particles of which are varied in size so that the spaces between them when they are mixed together will be a minimum. A concrete made of aggregates graded in this way in which sufficient water is used to make a mushy mass and which, when placed in the forms, is well tamped and spaded, will generally be waterproof, that is, unless the wall is thin. By spading is meant shoving a thin, sharp-edged tool down between the concrete and the forms and also shoving it down into the center of the mass while it is being placed. This forces the larger stones back from the face of the concrete, and allows a mixture of rich grout to come to the exposed surface of the work, and releases bubbles of air in the center of the mass that would otherwise leave hollow spaces. Additional density can be secured by painting the surface of the concrete. (See page 34.)

It is very difficult, where a wall has already been built and found to be porous, to correct the trouble from the inside. It can be done by building an extra 4-inch wall with an open space of from 1 to 1½ inches between that and the old wall and providing a way for the water to flow out from this space into a drain; or by applying pitch and felt and an extra wall or layer of dense concrete, but by this method the floor must be a continuous, dense slab of concrete, otherwise the water will find its way under the floor and come up through that. Correction from the inside is troublesome and costly. It is better to get at the leak from the outside and by the application of tar and felt, a waterproofing compound or by a supplemental wall or mass of dense concrete on the outside, to keep the water away from the porous wall. As a matter of precaution, a drain should also be laid.









What is a simple rule for determining the amount of cement required by a certain proportion?

The following rule is one used by some contractors in getting a quick, general estimate of the cement required: Divide the total of the figures representing the proportions into 11 and use the result as the number of barrels of cement needed for a cubic yard of concrete. To illustrate: The proportions are 1:3:6, the total of 10 divided into 11 gives 1 1-10 as the number of barrels of cement required for each cubic yard of the volume to be filled. This rule gives approximately correct results.

During September, when we had some very cool nights, some concrete that I had in forms looked as if it were not going to set at all. I complained about the cement but let the forms stay and a week later the concrete was as hard as a rock. Can you explain this? I am sure the concrete did not freeze much, if any.

The following extract from the *Engineering News* answers this question well:

"The fact is that while most constructors realize that concrete will not set in freezing weather, many do not appreciate that from 45° F. down to freezing there is a definite slowing up of the setting, which is actually more dangerous than a complete failure to set. Anyone ought to be able to recognize a frozen concrete; it takes a much higher degree of skill to determine a working-strength set.

'During the later fall, in most parts of this country, night temperatures will be hovering around freezing, although in the daytime artificial heating of the concrete will rarely be required. In consequence, much concrete from which normally the centers could be removed in two or three weeks, will be so retarded in

set as to be dangerously near failure, unless supported for a week or two weeks beyond the standard period. If the discouraging records of all the autumns of the last ten years are not to be repeated, every man responsible for the laying of reinforced concrete will study his thermometer during October and November and be quick to protect his forms when the temperature gets into the forties."

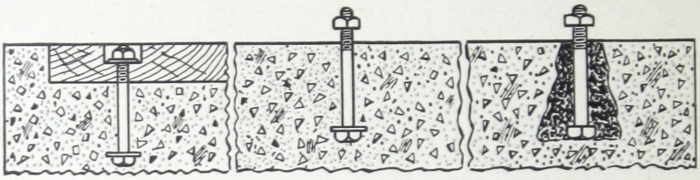


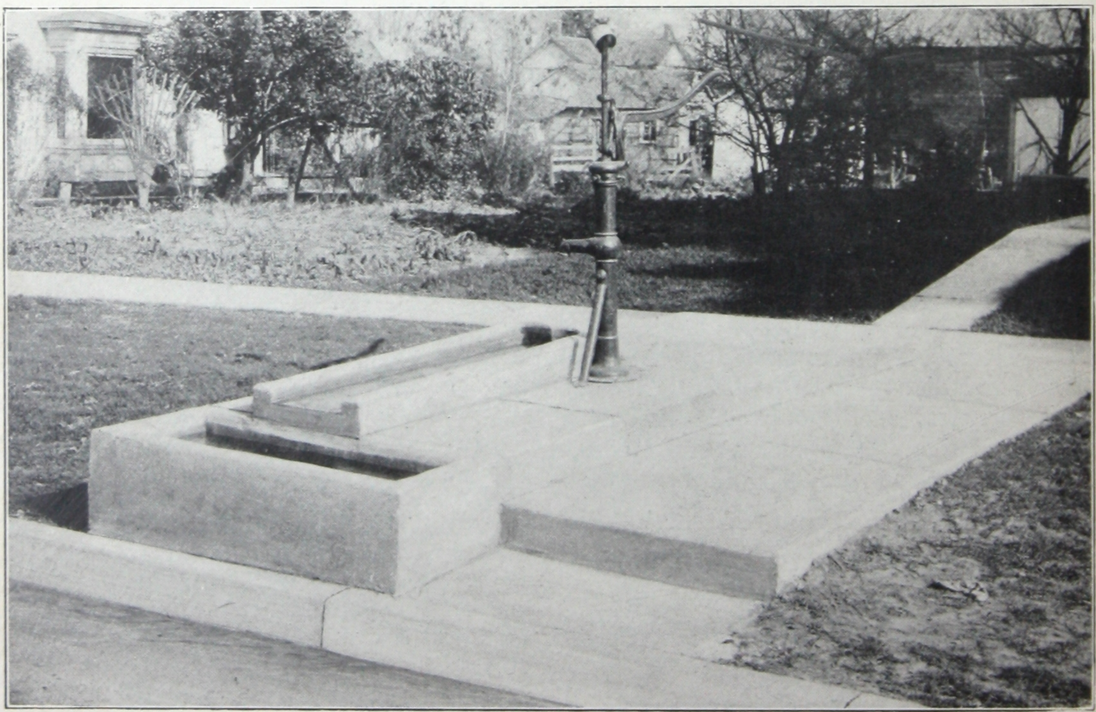
FIG. 1 FIG. 2 FIG. 3

I intend to put a cement floor in a small power house in which will be installed a gasoline engine that will be used for pumping, running cream separator, etc. How can I lay the floor so as to provide for bolting the engine down firmly?

There are two ways of doing this: one is to anchor pieces of hard wood, say 4 in. x 4 in. timber in your concrete in the manner shown in Fig. 1, where the timber is set flush with the floor and is countersunk for a nut and washer.

The other would be to set the anchor bolts in the concrete permanently (see Fig. 2). This can be done by making a wooden template of the base of the engine (a frame that will accurately locate all bolts and suspend them in position); place this template in the position desired and fix the anchor bolts in the template at a proper distance above the floor.

If the cement floor is already laid and you desire to anchor a gasoline engine to it, holes can be drilled in the concrete, as illustrated by Fig. 3, and anchor bolts securely fastened by lead, melted sulphur, or a rich cement grout. These holes can be drilled with an ordinary hand drill such as is used for drilling rock. Be sure the holes are drilled deep enough to give you a secure fastening for the engine, then place the bolts in the holes so that they extend at a proper distance above the floor, and pour lead, melted sulphur or rich grout ("soupy" cement mixture) around them.



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Foundation and Hatchway	**Septic Tank**	**Hog House**	**Garages and Runways**
Gutter and Curb	**Oil Storage Tank**	**Dipping Vat**	**Cement Stucco**
Storage Cellar	**Water Tanks**	**Piers for Small Boats**	**Cement Chimneys and Fireplaces**
Small Warehouses	**Tennis Court**	**Garden Furniture**	**Cold Weather Concreting**
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